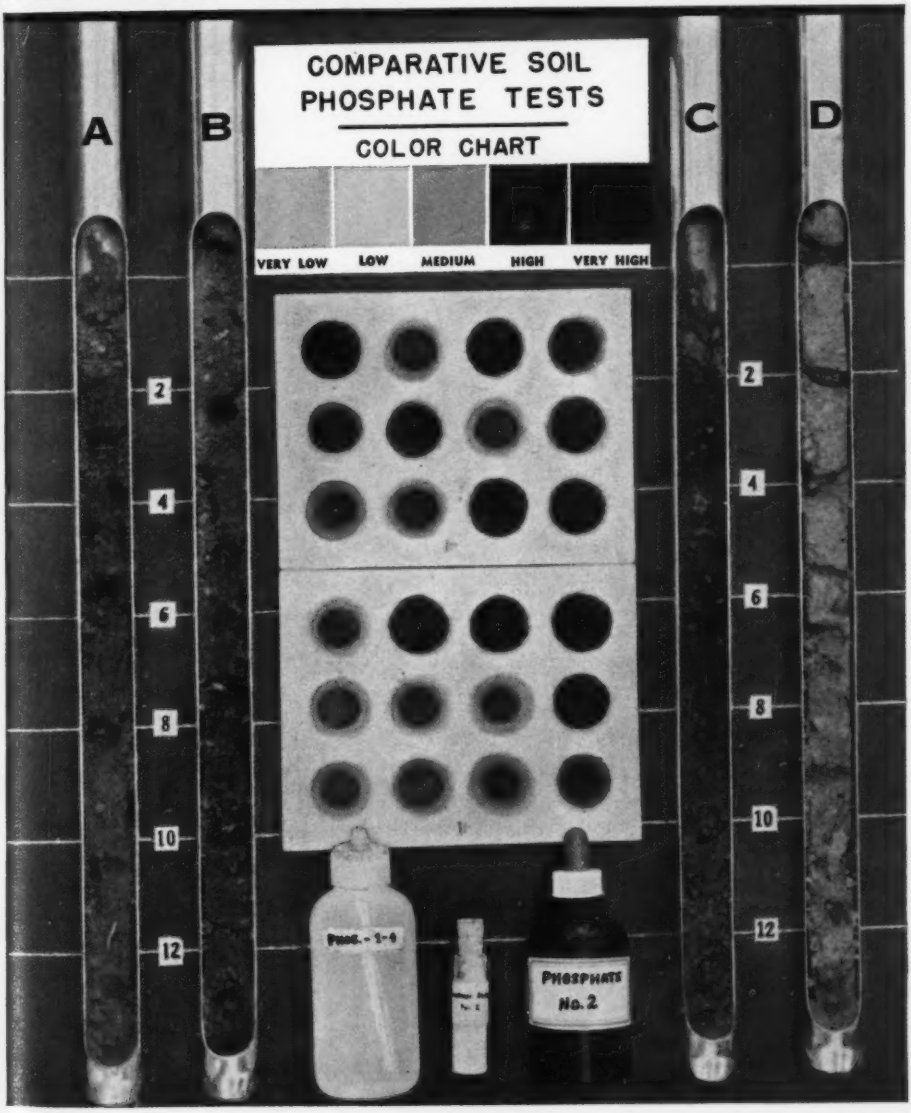
Better Crops WITH PLANT FOOD

November 1953 10 Cents



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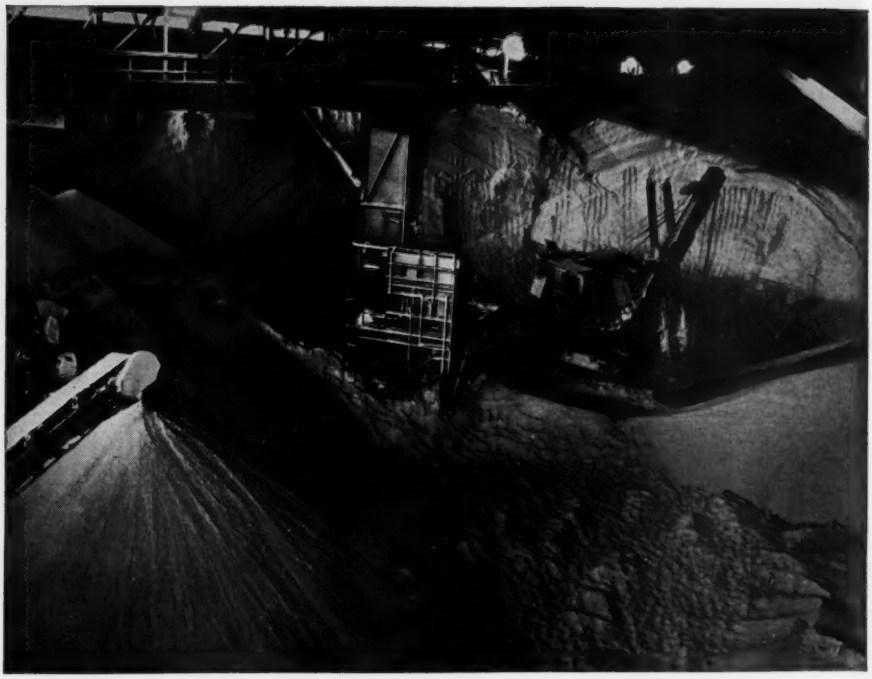
The Pocket Book of Agriculture



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THE AMERICAN POTASH INSTITUTE

1102 Sixteenth St., N. W. Washington 6, D. C.

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXVII NO. 9

TABLE OF CONTENTS, NOVEMBER 1953

More Ammunition 3
Jeff Reviews Research and Education

Growing Broccoli at Veg-Acre Farms 6
An Achievement Story by William Richards

Sunshine Is Our Life 11
Frank E. Shestock Discusses the Role of Potassium

The Importance of Legumes in Dairy Pastures 13
R. E. Hodgson Gives Results of Experimental Work

Boron—Important to Crops 17
Arthur L. Prince Presents Supporting Evidence

Outdoor Manger Replaces the Old Barn 20
R. H. Lush Sets Forth the Advantages

Conditioning Soils in the Southwest 22
Richard M. Marshall Sees the Need

A Convenient Quick-test for Potash in Coastal Plains Soils 25
Seton N. Edson Outlines the Procedure

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Frozen Assets!

Better Crops with PLANT FOOD

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Vol. XXXVII WASHINGTON, D. C., NOVEMBER 1953 No. 9

More Ammunition

Jeff McDermid

FARM research and education have been kept pretty well out of the rough-and-tumble arena of political campaigns. At least in a broad, national way they have not played such a stellar role as those controversial features of the national farm program — acreage allotments, price supports, non-recourse loans, and aid to underprivileged farmers. Maybe controversy is sometimes good for any movement, to get its lard tried out. Perhaps a stiff argument is often a good way to focus attention on the needed improvements of a system—even such a fairly good and sound system as farm research and education.

Farm research and education have been looked upon approvingly, in general as a virtue. Those most set against spending public funds for overhead projects have raised but few objections to using them for finding out new farm facts and routing them out to the countryside. The fuss has been raised over the "economic sins" involved in subsidy and easy loan programs for farmers, and not very generally on getting the newer knowledge for and to them—which is presumed to provide virtue with its own automatic reward.

Recently new emphasis has been placed by the chief spokesmen for agriculture, (both Federal and State), upon strengthening farming through education and research. It is proclaimed that the soundest approach to lower farm costs, improved quality of products, and expanded market outlets is bound to be in the direction of more organized research and better and more widespread system of extension education.

The nub of the dilemma in the eyes of some seems to be that farm research is not making the pioneer discoveries that it needs to make if the gains in farm technique and production are to be raised fast enough to keep up with the demand from population pressures.

More of those lines of research known as "basic" or "fundamental" are badly wanted—such as those which led to the eradication of cattle ticks and tuberculosis, discovery of photo-synthesis in plants, the Mendelian laws of heredity, and, more recently, in antibiotics, selective herbicides, and radio-isotopes. Researchers are kept busy applying former factual data to the scheme of life in soils, plants, and animals, and possibly finding out too few new revolutionary basic discoveries.

SOME observers say that in the popularized field of marketing research not too much has been done, either to ease the heavier operating costs of the farmer or to provide consumers with incentives to buy food more freely and without grumbling at prices or quality.

No doubt many consumers are bound to gripe anyhow, but their education is sadly lacking in regard to reasons why food costs lots to raise and deliver. However, farm research and education have failed to get to them regularly with enough cogent and convincing proof. They hear about easier store operations and short cuts to service and using good displays to bait the hook of appetite, and savings in transportation charges and better bookkeeping methods for cashiers—but they can't usually see much evidence showing up in direct benefit to their own costs or market-basket bills. It's there, somewhat obscured by trade jargon, but few see it clearly enough. Probably anything that gets greater operating satisfaction at both ends is contributing its share all right, but so far this form of research has failed to make "investigations" into market spreads useless.

The farmer still risks the costs of doing business against bounteous harvests. Research has not told him how to live with abundance, except to borrow money from public or private sources to tide him over a spell of bad weather—when his worry is shifted from plenty to scarcity. In either case the consumer's head swims with confusion and he squawks for all it's worth.

That is to say, thus far our scientific farm research has accomplished wondrous things for the individual producer or the corporation farm in its balance sheet of volume and quality with far less manpower. But in the field of operations beyond the fence lines, where there is active competition for the consumer's dollar, there is some sense of failure and frustration evident. The number of so-called "producer-distributors" are still in a vast minority, except in a few selective specialized fields. Lower production costs are the mainstay in the defense of research, but mostly they are obtained through larger productive volume — and volume runs up against surplus and then we start all over again.

Much is expected of those who peddle research to the rural doorsteps. Most of these workers have done a great job. But their farm patrons are often put in the same spot as the guest who tried to be polite and plausible. At dinner he said to his host: "This is sure fine, what there is of it," quickly corrected to "Oh, there's a great plenty, such as it is."

WE hear so much now about improving communications through use of the "mass media." All the information lads are talking about this angle. Mass media is regarded as the main tool of education that spreads the results of research. The role of the small publisher or the little group or even the eager individual exponent has been drowned in the ocean of mass media. This often results in loss of man-to-man human appeal and the truth that lies in honest simplicity. Unless to begin with you have something sound and practical and appealing to communicate, all the rare new marvels and gadgets of modern mass education will not be worth much more than the pioneer system of fence chatting and visiting around.

Right here let's recall what was stated last year by Dr. Byron Shaw, Head

of the Agricultural Research Administration:

"Except for potatoes, the research frontier for all farm commodities of much value is now at or is rapidly approaching the stage where opposing forces like insects, diseases, soil failure are pushing down as hard as science is pushing up. The ceiling for the average producer is still rising for most commodities. With pork production per 100 pounds of feed, the potential advance from the most recent lifting of the pork research feeding ceiling is a future possibility. But in general, the data show clearly that we have used up a lot of our reserve of scientific knowledge in the last 10 to 15 years. Under these conditions we can expect a leveling off in the average producer's ceiling in the future unless the research frontier is again pushed up."

He and others of like opinion believe that a favorable position for the nation would be one where new research findings are being developed at a rate equal to or preferably greater than the rate at which current findings are being put into farm practice. Then we would always have some reserve potential of productive power that could be called forth in any grave emergency. We would also have more assurance of meeting the needs of a rapidly growing population.

The response of the average producer to new and workable farm research advances involves a time delay of 10 to 15 years. Hence the time to start moving into the unknown frontiers of science is right now. It is claimed that the producer and others served by science usually determine the quantity of research which is increased. But the decision on the quality of research, leaders think, rests largely with agricultural scientists.

Now this discussion of time lag between new findings and their farm usage sometimes overlooks a segment of our farm life that drags its feet. Official reckonings based on the census and kindred data tell us that nearly one-third of the manpower on all our commercial farms is represented by numerous areas of low-power production that actually raise only one-tenth of the total food and fiber we boast. With a third of our commercial farm labor expended in slow and profitless forms of output, it would seem that the field of research must reach out into the fields of human relations to recover that exhausted potential.

In other words, we must find practical ways to raise the level of opportunity and productive ability among thousands of American farmers whom no amount of extension education alone can emancipate. It's not just a case of ignorance or indifference to these people mired in despond and minus enough land or equipment. The root of the dilemma with them lies in financial and managerial inability to compete with the other two-thirds of our commercial family farms whose skill accounts for nine-tenths of the harvests we enjoy.

This need not take the form of handouts or paternalism, as it is distasteful for even the poorer farmers to be public wards. But there can be a greater degree of willingness on the part of country banks to do their share in sifting out these better risks and then working with county extension forces to help farmers plan and manage for larger units and the use of more mod-

(*Turn to page* 51)

Growing Broccoli at Veg-Acre Farms

By William Richards

Sandwich, Massachusetts

VEG-ACRE Farms, owned and operated by this writer, are located in Sandwich on Cape Cod, Massachusetts. While this location is remote from other vegetable growing areas, it provides a large area of relatively good soil. At the time this 600-acre farm was purchased, only 70 acres were cleared. Now, the scrub oak and pine, so common to Cape Cod, have been cut and 300 acres are under cultivation. Approximately two-thirds of this acreage is devoted to iceberg lettuce and broccoli. Alfalfa, to provide a cover crop and organic nitrogen, is grown in rotation, occupying each year about one-third of the cleared land.

Early in our operation we turned to broccoli as a sure-money crop. None of the many varieties of broccoli that we tried was entirely satisfactory. About that time Professor Robert E. Young of the Waltham Field Station of the University of Massachusetts started a breeding program to produce a better variety. We cooperated in this program by growing the many breeding lines here at Veg-Acres at the same time they were also grown at Waltham. Out of this work came Waltham 29 variety, and while this was developed for fresh market broccoli here in Massachusetts, it has also done well as a broccoli for freezing. The variety is now being grown in almost all parts of the country and it seems to do particularly well in New Jersey, Maryland, and on the Eastern shore. It is a variety for summer and fall use as it requires warm weather for proper development of the small plants.

Description of Variety

Waltham No. 29 broccoli is a low-growing, heavy, compact plant that produces a large, heavy central head with buds that are medium to small in size, evenly distributed, with no yellow "eyes" showing. Both the plant and head have a dark blue-green color. It is a slow-growing plant and so is able to come through periods of hot weather without the heads opening up. Because of its uniformity, a large portion of the crop matures at one time. In turn, a large number of side-shoots are ready for harvest at the same time, thus reducing harvest costs considerably. After the center head has been cut, the plant produces a big crop of large side-shoots on branches from low down on the plant. It is not uncommon for over a pound of stripped shoots to be taken from a single plant at one time. After the primary side-shoots are cut, the plant will continue to produce heads of medium size if the growing season is sufficiently long.

Veg-Acre Production Practices

In the discussion which follows we shall attempt to record the essential production practices which have proved profitable with us. This effort on our part is prompted by travel to broccoli-producing areas where the crop was producing only a part of what could be obtained, chiefly because of the failure of growers to provide proper growing conditions.

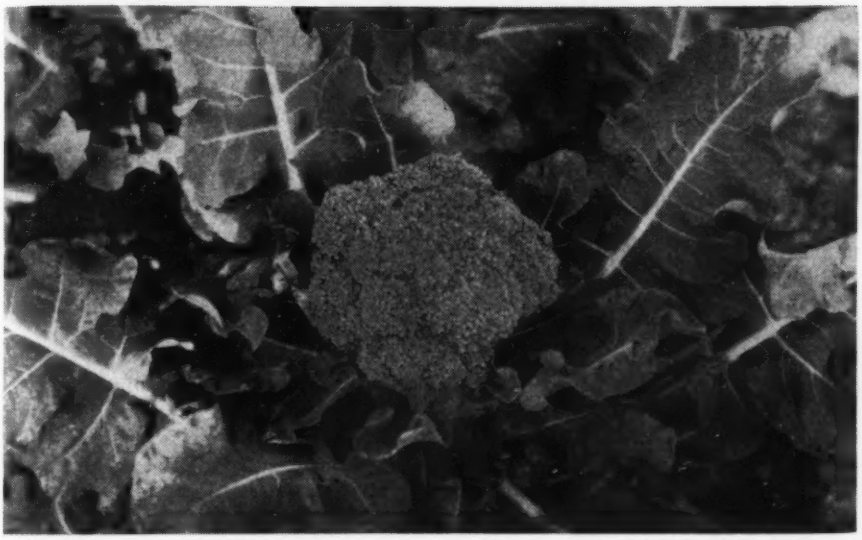

Fig. 1. A typical plant of Waltham No. 29 Broccoli showing large, heavy central head. Heads like these are the pride of Veg-Acre Farms.

First of all, we would like to point out that Waltham 29 broccoli, when properly grown, has been bred to produce large crops and to continue to produce over a long period. Here in New England, because of limited acreage, high costs of production, and competition from other areas, it is necessary to obtain maximum yields at all times. We always shoot for "top yields" and seldom, if ever, does it pay to reduce growing expenses short of this aim.

High quality is usually associated with the "top crop" and with both of these come lower harvesting costs and lower unit cost of growing.

We consider it a fair statement of fact that Waltham 29 has a higher potential of production to start with than any other variety of broccoli. Therefore, under proper growing conditions, it will produce the largest crops.

Soil Preparation

The soil at Veg-Acres is a light to medium sandy loam underlaid with a sandy gravel. We never find a season that some irrigation does not pay. The soil is quite retentive of phosphate and potash, but being sandy the nitrogen is easily leached away. All during the making of the crop we must watch the nitrogen level.

The fields set to broccoli come from two plans in our rotation: they have either been in cover crop (alfalfa or sweet clover) or they have been in a spring crop of iceberg lettuce.

Plowing is by moldboard-type plows to 7 or 8 inches deep. Soil tests are made and lime is applied after plowing if either the pH is below 6.5 or the calcium level is below "very high" (Morgan method). The whole aim of the fertility program is to make the broccoli crop grow very, very fast all the way. It cannot do this without plenty of calcium for rapid root growth.

Club Root disease has always been a problem in this area, and a high pH seems to be helpful in control. The new roots that grow from the transplanted plant into heavily limed soil seem to have less Club Root than those from a plant transplanted into acid soil.

Fertilizer Program

After the lime has been disked into the soil, the fertilizer is applied. This fertilizer program is the result of 17

years of experience and experiments with broccoli. To get an idea of what the crop requires in the way of fertilizer, we have always made it a practice to pull and weigh a number of full-grown plants to see what kind of tonnage we are growing. Since the introduction of Waltham 29, the weight of the plants has increased substantially, and an average plant will weigh about 8 pounds. With 9,600 plants per acre this means 76,800 pounds of plants, and this does not include most of the root system. Understand that this tremendous quantity —38 tons per acre—must be grown in just 8 weeks; then consider the amount of plant food necessary.

From analysis of the plant we find that to grow 38 tons of broccoli plants per acre will require 270 pounds of nitrogen, 76 pounds of phosphoric acid, and 360 pounds of potash. All of this must be readily available at the right time for fast entry into the plant. It must be remembered that only about ⅕ of the phosphorus applied will be available to the plant and that certain amounts of plant food are leached away or made unavailable to the plant.

We like to keep our soils at a high level of fertility at all times, and at the start of the crop the soil tests usually show "high" in both phosphorus and potash. To supply the large amounts of plant food indicated above we broadcast 2,500 pounds of an 0-14-14 fertilizer per acre, which supplies 350 pounds each of phosphoric acid and potash. Experience has shown that this fertilizer, along with what is in the soil, is ample to produce the high crop if care is given other factors.

We don't find it quite so easy to handle the nitrogen feeding. Where we plow under the legume green manure we let the nitrogen in this (100-200 pounds per acre) start the growth, and then we come in fast with topdressing of ammonium nitrate at the rate of 200 pounds per acre. Two or three applications are usually necessary to maintain a good nitrate level. If we have excessive rains, more nitrogen is required. Where we do not plow under the cover crop we use 300 pounds of ammonium nitrate to start. This is about the same as applying 1½ tons of 4-12-12 fertilizer per acre. The topdressing program is the same

Fig. 2. After central head has been cut, it is not unusual to find plants producing a crop of side shoots like these. A pound or more of stripped side shoots may be harvested at one time. High level of soil fertility is essential.

Fig. 3. A mobile packing shed is used for harvesting at Veg-Acre Farms. Broccoli is stripped in the field, bunched, tied with machine, wrapped, and crated. This all-in-one operation saves labor and lowers harvesting cost.

as where cover crop is plowed under.

Minor Elements

Where we maintain a high pH in the soil, for Club Root control, we have 50 pounds of manganese sulphate, 50 pounds of iron sulphate, and 50 pounds of borax mixed in each ton of 0-14-14 fertilizer. Even though we start with 50 pounds of borax per acre, we have found that it requires two additional topdressings at the rate of 20 pounds per acre each time.

It has been our experience that without adequate borax, broccoli will not grow fast, either in the young plant, the headed plant, or the shoot stage. We might add that three-quarters of all the broccoli acreage we have ever seen has been moderately to severely short of borax.

Boron-deficient plants are easily recognized by the puckering at the edges of the leaves on the new growth, distorted, rotted heads, and hollow stems on older plants. Perhaps no plant has had so many emergency applications of a minor element as has the broccoli with borax within the last five years. Where possible, a spray will act fastest. We use technical-grade powdered borax, as the fertilizer grade does not go into solution properly. The powdered borax is sifted onto the sprayer screen as the water is added. We have also applied borax as a dust with the dusting machine and by hand-spread applications. All of these methods have been successful in correcting boron trouble. A big crop of shoots cannot be kept growing fast without sufficient borax on the tail end of the crop. Unlike some elements, boron does not seem to be moved from one part of the plant to another.

Growing Plants

We grow our plants on the same principle as we grow the crop—feed them heavily and grow them fast; have them loaded with nutrients ready to go to work. We cannot subscribe to the theory of starving the plant bed to produce a "tough" plant.

We like to seed in rows 18 inches apart with about 10 plants per foot. We usually use the No. 6 hole on the Planet Jr. seeder. On our farm it takes exactly 28 days to get a large heavy plant with a stem ⅜ to ¾ of an inch thick. We dust or spray the seedbed with Spergon from the time the seeds

crack the ground to prevent mildew and with DDT to control the worms.

We set the plants without water in the transplanter, as we always follow the setting with irrigation. A week after the plants are set we cultivate so as to level in the furrows left by the transplanter and also to control the first crop of weeds. We cultivate rather deep and keep away from the plants to the extent of their root growth at that time. Two weeks later we make the second and last cultivation, and at this time we hill the plants fairly high so they can withstand the wind, and, of course, we also get the next crop of weeds. Here again, we are careful not to disturb the root system. We feel that it is important to get this cultivation done before the plants get too big. Cultivating and hilling after the plants are too large will cause considerable damage to the root system.

Spraying and Dusting

Most areas find it necessary to spray or dust for control of insects and plant diseases. Most common insects on broccoli are the cabbage worm, cabbage looper, and aphids. Control is good with DDT, TEPP, or Parathion.

The most common plant disease along the Atlantic seaboard is mildew. First symptoms are the small black dots on underside of leaves and on buds. Under proper weather conditions—warm and humid—these mildew spots develop and the spots developing in the buds are responsible for a soft rot in the bud. This disease has proven very damaging. In many cases the grower has not associated the mildew with the soft rot in the head. Here in New England, best control is with Spergon applied weekly from the time the plants emerge in the plant bed until the crop is marketable. Some areas are able to eliminate the early applications, but we have yet to see the area that could not profitably control the disease when the plants are in the budding stage. Undoubtedly, other fungicides will do a good job here also.

Soon after the second cultivation we start our spraying and dusting program with Spergon for the mildew and Parathion to control worms and aphids. The most important spraying of the whole season is done just as the center bud is forming. It is important to get the aphids under control to prevent them from hiding in the center of the tight head where it is practically impossible to get at them. We have found it necessary to keep up our spraying program, and we use Spergon up to within one week of harvest.

Irrigation

An abundance of water is essential for production of high yields of broccoli. Because of the danger of rainfall deficiency or poor distribution during the growing season we soon realized an irrigation system was needed. Every field at Veg-Acres has been equipped with permanent underground irrigation lines. Whenever there is a moisture defficiency we can turn on the water in a matter of minutes. Several times in recent years, irrigation has saved our crops. Viewed in the light of profits from the growing of broccoli, our irrigation has fully justified the cost. Without it our story would have been one of poverty production and low or no profits.

Harvesting

Eight weeks after the plants are set, the crop comes in very rapidly, and for the next three months it is a real race to keep up with the steady flow of heads and then shoots. The first eight weeks of cutting, during September and October, we harvest every five days, and over the last month we cut according to the weather. In 1952 we harvested up to the 19th of December. This crop had frozen down to 14 degrees four times and frozen in the 20's many times.

We hope that growers in other areas will find the above program of interest in making comparisons with their own methods of production.

Sunshine Is Our Life

By Frank E. Shestock

Algoma, Wisconsin

POTASSIUM as used in plant growth has been given the popular name of Sugar Maker. It is an accepted fact that potassium in some way helps make sugar in the green leaves in the presence of sunlight. Without potassium plants make only a weak growth and soon die. It is evident that without it plants do not reach maturity and there is no perpetuation. Soils lacking potassium become barren wastes.

Potassium is the dominant mineral element in the plant kingdom. By the same token, calcium is the dominant mineral element in the animal kingdom.

While we are putting potassium in the limelight, let us review its reputation of being the dominant mineral element in the plant kingdom. It is the most abundant mineral element in our useful plants as long as they are living and growing. The ash of living plants often contains potassium to the extent of 50%. The ash of a potato may be 60% potassium. Most of our useful plants under good growing conditions contain from 1½% to 2% potassium in the green leaves. Potato leaves seem to contain much more. We have become quite concerned with dried edges on green leaves as that is a telltale sign of potassium deficiency. Plants that gather much energy from the sun and store large quantities of sugar, starch, oils, fiber, and protein are usually heavy users of potassium.

To grow large crops it is necessary that the potassium in the green leaves be kept at the proper level during the entire growing season. It is a case of first things first. Other mineral elements are also important but potassium holds the key position since it is potassium that helps lock the energy from the sun in simple sugar. The potassium in the plant is a soluble compound of small molecular size that has filtered into the roots with the soil moisture. A soil may have 20 tons of potassium in the plow depth of an acre and more underneath and yet the plants may suffer from a deficiency unless the soil has enough potassium in a form that can enter into the roots.

Potassium seems to be the connecting link between the energy of the sun and the substance of the earth, whereby plant and animal life as well as humanity can exist; potassium is the dividing line between starvation and proper nourishment—between a lifeless world and a happily populated one.

Sugar Making

What is this process of sugar making in the green leaf, in the presence of sunlight and with the aid of potassium? Just what does happen would be difficult if not impossible to explain. There may be a number of processes before such a tangible product as simple sugar is produced. For our purpose it does not matter what these intricate processes are. We do know that in the green leaves of plants there is a substance called chlorophyl which has the power of synthesizing sugar out of water and carbon dioxide in the presence of sunlight and with the aid of potassium. Thus a few molecules of water (H_2O) and carbon dioxide (CO_2) form a molecule of simple sugar such as $C_6H_{12}O_6$.

If we were to say that $C_6H_{12}O_6$ is all there is to this form of sugar and this combination of elements was sugar, we

would be telling less than half the truth. It would be like calling an empty house a home. We know that sugar contains energy. If we burn it, heat is given off. If we eat it, it gives us nourishment—the power to keep warm and to move. This energy is not the property of the water or carbon dioxide or of the elements that make the chemical symbol of sugar or of the rich soil or fertilizer added to it. These substances are merely the building blocks that become the home of the trapped energy from the sun.

We have been taking the sun as a matter of course. It has always been in the skies. We miss it in the winter months when its rays are weak or on dark days when they cannot penetrate the clouds. We avoid it when it is excessively hot. We are apt to regard the sun in the sense of our comfort without realizing that the sun actually sustains our lives with the energy gathered by plants and locked in organic compounds which eventually become our foods whether they are bread, butter, meat, vegetables, fruit, or other things we eat.

The simple sugar made in the leaf in the presence of sunlight and with the aid of potassium may be compared to a wound-up clock in which the energy in the spring is a dynamic force that tends to escape by moving the pendulum back and forth. In the plant the stored energy is also a dynamic or driving force that tries to free itself by breaking up the sugar compound and forming other compounds when moisture and temperature conditions are favorable and the helpers, the catalysts and enzymes, and the necessary chemical elements are available. The pendulum of a clock will move back and forth many times before the energy in the spring is used up. In the plant the stored energy will force many chemical changes during its life. While a crop is growing there is a gradual accumulation of energy even if much energy has been lost in promoting the chemical changes or building-up processes. Thus the peak of stored energy in a plant is at the time of the maturity of its crop. We are well aware that corn contains the most feed value when it is ripe. Any chemical changes in the corn after that lower its feed value because some energy has been given off in the breaking-down processes. The same holds true with the heating of high-moisture hay and grain. Likewise, decayed wood has very little fuel value. Under favorable conditions the break-down processes will go on until all energy is gone. In our bodies the catabolism or break-down processes of organic substances go on, giving us energy to sustain our lives.

Potassium, a Catalyst?

Since potassium seems to speed up the process of making sugar out of water and carbon dioxide in the green leaves of a plant in the presence of sunlight without entering into the chemical compound, may we say that potassium acts as a catalyst? If it were not for catalysts many chemical reactions would go on very slowly or not at all. Progress in the chemical industries depends on finding the right catalysts to combine elements into the desired combinations. There are catalysts, namely the enzymes, in our digestive systems to speed up the breaking down of our foods so that our bodies can be nourished. There are systems of enzymes in plants that help build up the sugar produced in the leaves into substances that each kind of a plant has a creative power to produce. Thus it appears that each species of plants has an enzyme system of its own. The enzyme system of a carrot must necessarily be different from the enzyme system of a watermelon. In each case the plant starts out with some form of simple sugar as its raw material, which was formed in the green leaves in the presence of sunlight and with the aid of potassium.

We can compare the chemical processes in a plant to an assembly line in

(*Turn to page* 43)

Fig. 1. Dairy cows on alfalfa-brome pasture in Iowa. Popularity of this mixture poses the problem of fertilization and management to insure dominance of the grass in this mixture.

The Importance of Legumes in Dairy Pastures

By R. E. Hodgson

Bureau of Dairy Industry, U. S. Department of Agriculture, Beltsville, Maryland

GRASS is the forgiveness of nature—her constant benediction. These words, written in 1872 by the Honorable John J. Ingalls of Kansas, truly bespeak the importance and dependence that society has long placed on this important crop of many uses.

Grass takes on added significance in our agricultural economy as we, through necessity and wisdom, turn our efforts toward a grassland agriculture. But grass in the concept of grassland agriculture is not limited to the grasses; it embraces also the common association of the legumes—the clovers, alfalfa, lespedeza, and many others. Man in his association with grass, using it as an important crop to manage his farm land properly and to provide feed for his livestock, has learned that grass will yield greater returns when it is grown with legumes.

The Need for High-Yielding Pastures

Pasture and grass are almost synonymous terms to the livestock farmer. Pasture is our most important agricultural crop, and it is destined to become even more important as we learn to grow and manage it in ways that favor its maximum production and utilization.

We have been careless and neglect-

ful of our grasslands. Only in recent years have we appreciated what grass contributes to soil conservation, good land management, and agricultural production — especially livestock production. We have been in the habit of taking pasture for granted—turning our livestock on it as soon as possible in the spring and taking them off as late as possible in the fall. In the dry summer months we complain that milk production and weight gains are too low, but we fail to realize that our pastures are not cared for well enough to provide the grazing needed to keep livestock production up.

On the average, pastures have been low-yielding crops compared to other crops. It is difficult to obtain good information on the yield of farm pastures. I estimate that they yield no more nutrients per season than the average hay crop, which, according to the Bureau of Agricultural Economics, was 1.45 tons, or about 1,500 pounds of total digestible nutrients, per acre in 1951. Some time ago I estimated that the average dairy cow in the United States obtained a total of 1,542, 1,343, and 1,269 pounds of TDN from pasture in the years 1939, 1943, and 1947, respectively.[1]

I do not know how many acres of pasture were required on the average to support a cow, but certainly no less than 1 acre was required. The average increase in the per-acre yield of hay from 1935 to 1950 amounted to only 6 per cent, while that for corn was 56 per cent; oats, 15 per cent; and barley, 16 per cent. I doubt very much that the yield of pastures has increased to any greater extent than that for hay. This, to me, means that we have been neglecting our pasture and forage crops. This is true from the standpoint of research as well as extension education and application. Of course, there are many examples on farms and at experiment stations of pastures returning yields of 4,000 to 5,000 pounds of TDN per season, but we need many, many more such pastures on our farms.

Let us look at this for a moment from the standpoint of our national milk production and its relation to the needs of the people. In the last 10 years, the per capita production of milk has fallen from 880 pounds to 770 pounds. Our population is increasing by about 2 million people a year while our dairy-cow population is constantly decreasing. It is true that the average milk production per cow increased steadily by about 75 pounds per year from 1935 to 1950. This has prevented a more drastic reduction in per capita production. But what of the future?

My calculations indicate that with the present dairy-cow population, if we can keep up the rate of increase in production per cow that was obtained in the past, we can continue to provide our increasing population with as much milk per capita as was available in 1950.

But how are we going to do this? I believe we can do it by increasing the supply of good-quality pasture and harvested forages for our dairy cattle; in other words, by getting more milk per acre. Most of the increase in production per cow from 1935 to 1950 can be accounted for by increases in the rate of grain feeding and not by larger amounts of forage. Our dairy cows on the average are underfed on pasture and other forage.

The opportunity for increasing milk production of the average dairy cow, at low cost, is through the production and feeding of more forages of better quality; and of these, pasture is by far the most important.

Legumes and the Bloat Problem

In the improvement of pastures in most areas of the country, especially in the humid areas, legumes must play an important part. The inclusion of legumes as an important part of the mixed herbage, or their use in relatively pure stands, produces greater

[1] From Table I, page 5, of U. S. Dept. Agr., Bur. Dairy Indus. BDI-Inf-115, Our dairy cows could use more good roughage.

returns than the use of grasses alone.

The one great deterrent to the use of legumes for pasture is the danger of bloat, and this is a very real road block. I am told that particularly in the Southeast, the bloat problem, caused apparently by the presence of large amounts of ladino clover in improved pastures, is a major factor limiting the pasture improvement programs in that area. The farmers in California have had a lot of experience with cattle bloating on alfalfa pasture. It is no new story to them.

Surveys show that relatively few, perhaps less than 1 per cent, of the grazing animals studied were attacked, or succumbed to bloat. However, this is not a very impressive statistic to an individual farmer who looks out into the pasture to see 5 or 10 of his valuable high-producing milk cows down with bloat.

Bloat is not a problem that can be brushed off lightly. It is a problem that must be met. It is the job of our research workers to find out the causes of bloat and develop ways to avoid it, and it is the job of our extension workers to educate the farmer on how to manage his pastures and his cows to prevent the occurrence of bloat. Our research workers — plant breeders, agronomists, dairy husbandmen, chemists, bacteriologists, and rumenologists alike—have an important job to do on this problem. We cannot afford to allow the fear of bloat in grazing animals to stand in the way of the development of high-yielding pastures on our farms through the use of legumes.

The influence of legumes in the pasture sward is apparent in the soil, in the herbage, in the cow, and in her milk. The beneficial effects of growing legumes in association with grasses may be summarized as follows: (1) There is an increase in crop yield; (2) nitrogen fertility of the soil is maintained or increased; (3) there is an improvement in the texture of the soil; (4) there is an increase in the protein content of the grass and of the total crop; (5) there is an increase in the calcium content of the crop; (6) there is an increase in the palatability of the herbage; (7) there is a stimulating effect on the yield of succeeding crops;

Fig. 2. Solid stands of perennial legumes like this white clover field need to be carefully managed if possible losses from bloat are to be avoided. Plenty of water and salt and conveniently located stands of dry hay should be available in such pastures. Important with dairy cows particularly is the feeding of hay before turning onto such pastures. Grazing should be rigidly controlled, increasing gradually from one-half hour, when first turned on, to full-time grazing after about three weeks.

TABLE I.—NITRATES IN SOIL UNDER 5-YEAR-OLD STANDS OF ALFALFA AND TIMOTHY [1]

Crop	Soil treatment	Nitrates in soil [2]
		Parts per million NO_3 in dry soil
Alfalfa	Limed	4.4
	Not limed	8.3
Timothy	Limed	2.0
	Not limed	0.7

[1] Adapted from N. Y. (Cornell) Agr. Expt. Sta. Bul. 294 (1911).
[2] The quantity of nitrates removed annually by the alfalfa crop also was stated to be 3 to 4 times as great as for timothy.

(8) there are fewer weeds in the pasture; (9) there is a somewhat better distribution of forage growth throughout the season; and (10) by virtue of the higher carotene content of legumes the vitamin A value of milk is increased.

Surely these advantages, some of the more important of which I shall illustrate in more detail, are worthy of serious consideration by those desiring to develop high-yielding pastures. The advantages of using legumes for such purposes far outweigh any disadvantages, including the danger of bloat. What we need, along with the development of improved grass-legume pastures, is the development of scientific knowledge that will enable us to graze such pastures without incurring the danger of losing animals from bloat.

Pure stands of alfalfa and ladino clover, and grass-legume mixtures containing a high percentage of alfalfa or ladino clover, appear to be the worst offenders in causing bloat. On the other hand, I am told that the legume trefoil never causes bloat; in fact, according to trefoil enthusiasts, it is instrumental in preventing bloat. Also, the outstanding work at the University of California, on factors that cause bloat and the use of such crops as sudan grass in preventing bloat, offers excellent leads for future work on this problem. It is not my purpose here to discuss the bloat problem from a research point of view. Rather, it is my purpose to justify the place of legumes in the pasture-improvement program.

Beneficial Effects of Legumes in Pastures

There is a considerable body of data available to show the benefits of legumes in pastures. Just what is needed to keep a desirable percentage of legumes in the mixture is not so apparent. We are all familiar with the important fact that micro-organisms populating the roots of legumes and the soil take nitrogen from the air and make it available to the plants—not only to the legumes but also to grasses grown in association with them. The influence of legumes (alfalfa) on the nitrogen content of the soil is illustrated in Table I.

This nitrogen-fixing property of legumes makes an important addition to the available supply of nitrogen for plant growth in the same manner as does commercial nitrogen. This is illustrated in Table II.

When ladino clover was grown with both orchard grass and tall fescue, it produced yields of dry matter and protein in excess of the amounts obtained from pure stands of these grasses grown on similar, adjacent soil to which had been added 160 pounds of commercial nitrogen per acre. Nitrogen produced by legumes has the advantage of being available over a longer period of time. Thus it is apparent that legumes such as ladino clover can be used to provide

(*Turn to page* 40)

Boron — Important to Crops*

By Arthur L. Prince

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BORON has been studied to a greater extent in the past 40 years than any other minor element required by plants. As a result, a voluminous amount of literature on this element has been assembled. A large part of this literature deals with descriptions of deficiency symptoms brought about by a lack of boron or with plant-injury symptoms induced by an excess of it. Consequently we now have adequate descriptive material for diagnosing deficiency and toxicity symptoms.

Reports of studies on the content of boron in soils and plants also occupy a considerable portion of the literature. More recent studies have had to do with the availability of soil boron to plants under varying soil conditions, such as pH, organic matter, texture, and moisture, and the influence of other cations and anions on boron metabolism in plants. More basic and fundamental types of research on boron as an essential plant nutrient are now the main concern of those interested in this problem. We need to know more about the functions of this element in plants and about what actually happens when there is a deficiency or an excess of it in the plant.

In the soil, boron is found only in combination with oxygen in the form of the highly insoluble tourmaline. Wittstein and Apoiger (18) were the first to discover it in the seeds of plants in 1857, but it was not until 1895 that Jay (18) suggested, after many analyses, that boron might be universally distributed throughout the plant kingdom. For the next quarter century, investigations were concerned mostly with its toxic action and its stimulating effects. Aguthon's work (18), in 1910, indicated that boron was necessary for all higher plants and, along with Bertrand, in 1912 (18), he pointed out its significance in relation to practical agriculture. The outstanding work of Brenchley (7), in 1914, led to the establishment of the essential nature of boron in plant life. In 1915 Maze (18) showed that a small amount was essential for the growth of maize, and that an excess was injurious. His results were subsequently upheld by the extensive and thorough work of Warrington (24) and Brenchley and Warrington (8). It remained for Sommer and Lipman (19), in 1926, and Sommer (20), in 1927, to not only clearly show the indispensability of boron for plants but to point out the extreme precautions and careful techniques that are required in establishing the essential or non-essential nature of any of the trace elements for plant growth.

Many loam soils supply sufficient boron for most plants, but the sandier soils are quite likely to be deficient in it. Certain crops, such as the Leguminosae and Cruciferae, require more boron than others, and are relatively high in it. Bertrand and Silberstein (5) found that Graminae contained 2.3-5 mg. and Leguminosae 16.5-43 mg. boron per Kg. of dried plant. They also found that monocots

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were poorer in boron than decots.

In the absence of adequate amounts of boron, plants begin to die from the apices, disintegration progresses, and blackening or browning occurs in the tissues. Boron-deficiency symptoms are readily observable in cauliflower, brussels sprouts, kohlrabi, kale, broccoli, rutabagas, turnips, and sunflower. Cauliflower that is deficient in boron has small heads with brown spots, while rutabagas and turnips form brown and water-soaked areas in the flesh of the roots.

The total boron content of a soil is not a reliable indicator of the need for boron fertilization, since less than 5 per cent of the total boron is in an available form. Berger and Truog (3) correlated available (hot-water soluble) soil boron with the amount found in the leaves of table beets grown on the same soil. Acid-soluble boron did not correlate as well with the incidence of "black spot" in garden beets as hot-water-soluble boron. In another paper (4) these investigators showed a positive relation between available boron and per cent organic matter in acid soils. But in alkaline soils, pH exerted a greater influence on the availability of boron than did organic matter. Wisconsin soils having pH values below 7.3 and containing considerable organic matter, were adequately supplied with available boron.

New Jersey Soils Deficient

A large part of New Jersey lies in the Atlantic Coastal Plain region where plants are liable to be deficient in boron. Because of that fact a large amount of research has been devoted to this element in New Jersey. In this area, boron applied as borax has been found to be effective in alleviating such pathological conditions as "heart-rot" of sugar beets, "brown-heart" of sweet potatoes, "crack stem" of celery, "internal and external cork" of apples and "yellows" of alfalfa.

In 1940, Wolf (27) studied some of the factors influencing the availability of boron in Sassafras sandy loam, of which there is a large acreage in New Jersey. Working with radishes and cauliflower, he found that boron-deficiency symptoms occurred at pH levels approaching 7.0. It became increasingly severe at higher pH levels and was accompanied by a lower content of boron in the plant tissue. Using hydroxides to raise the pH of the soil, he found that magnesium caused the greatest reduction in availability of soil boron. Calcium, sodium, and potassium hydroxides had lesser effects, in the order named.

An intensive study of the boron needs of New Jersey soils was carried on by Reeve, Prince, and Bear (17) in 1944. This investigation involved both field and laboratory methods for determining the need by soils and crops, the amount present in different soils, and the physiological and chemical factors involved in the use of boron.

Turnips showed typical symptoms of boron deficiency on 42 of 156 farms on which they were sown for test purposes. Definite crop response was obtained from the use of borax on 12 per cent of 350 widely distributed farms on which test plots were established. Based on both laboratory and greenhouse tests, a water-soluble boron content of 0.35 ppm. of air-dry soil was set as the dividing line between boron-deficient and boron-adequate soils. Of 200 soil samples chosen from an equal number of New Jersey farms and submitted to laboratory test, 88 were found to be in the boron-deficient group. Of representative samples of 20 important soil types under special study at the Experiment Station, 8 were found to be deficient.

Crops growing on well-limed soils were found to be more responsive to borax treatments than those on very acid soils. Raising the pH of acid soils had little effect on their content of water-soluble boron. Loam and silt loam soils were shown to fix a great deal more boron than sands and sandy loams, and crops growing on the

heavier soils were less easily injured by heavy applications of borax. From 75 to 85 per cent of a 20-pound-an-acre application of borax was washed out of 7-inch depths of four soil types by leaching them with an amount of water equivalent to one-fourth the average annual rainfall of the State.

The amount of water-soluble boron in soils was materially increased by additions of green manures. Such organic materials as straw manure and cottonseed meal contained very little, however, and a good many tons of them would be required to supply as much of this element as does 10 pounds of borax.

Amounts to Apply

Marked increases in the yield of carrots, spinach, clover seed, and alfalfa were obtained by the use of 10- to 40-pound an acre applications of borax to the soil. Boron deficiency, as indicated by "yellows," was found to be common on the alfalfa fields in southern New Jersey. Alfalfa hay contained boron equivalent to nearly 2 pounds of borax a ton, when grown on soils that were adequately supplied with the element.

The Sassafras soils of southern New Jersey were shown to be conspicuously deficient, whereas the Collington soils were very well supplied with the element. Crops growing in Lakewood, Penn, Gloucester, Merrimac, and Wethersfield soils were frequently benefited by borax treatments, but those on the Dutchess, Washington, Dover, and Chester series were not.

Among the important crop plants, alfalfa, clover, spinach, celery, cabbage, cauliflower, tomatoes, turnips, rutabagas, beets, carrots, and radishes were shown to be most likely to need extra boron. Typical symptoms of deficiency were observed on all of these crops at various locations over the State. Snap beans, limas, soybeans, and sweet potatoes were found to be extremely sensitive to an overdose of borax, especially when growing on the sandier soils.

Among 55 grades of fertilizer offered for sale by 14 companies operating in New Jersey in 1942, 51 contained boron. The highest content found in any brand was equivalent to 5.52 pounds borax a ton. It was suggested that for all fertilizers sold in the State about 5 pounds borax a ton be added as a means of maintaining a fair supply of boron in the soil. In areas of marked deficiency, however, and for such high-boron requirement crops as alfalfa, clover, beets, turnips, celery, and cauliflower, heavier applications were believed to be required. The authors pointed out that great care must be exercised not to exceed the recommended rates of application of borax.

In 1949 Wallace and Bear (22) investigated the influence of potassium and boron on the nutrient-element balance in and growth of alfalfa. Plants grown in a high-potassium solution were found to contain less boron and were more severely boron-deficient when boron was lacking, whereas those grown in a low-potassium solution accumulated more boron, and showed more injury when boron was abundant. Boron-deficient alfalfa was characterized by hardening, crinkling, and yellow-mottling of the terminal leaves; boron toxicity by a brown, necrotic fringe on the lower leaves.

Cowperthwaite (11) studied the effect of 10 cation ratios on the growth and composition of Rutgers tomato plants with three levels of boron covering deficient, optimum, and toxic ranges. At the low-boron level, he found that boron-deficiency symptoms in the plants increased when the potassium content of the nutrient substrate was increased, regardless of variations in calcium and magnesium. The severity of the deficiency symptoms was largely associated with high potassium in the substrate and with an increase in the potassium content of the upper leaf tissue. Conversely, boron toxicity symptoms appeared less severe on plants grown at the highest-potassium levels.

(*Turn to page* 44)

Outdoor Manger Replaces the Old Barn

By R. H. Lush

Tennessee Agricultural Experiment Station, Knoxville, Tennessee

"KEEP cattle outside, where they can feed themselves when the labor supply is undependable."

That was the advice given to me a quarter of a century ago by a venerable South Louisiana friend, when winter pasture tests were initiated on his farm. Since that time, we and thousands of others have learned a lot about keeping the "outdoor manger" full, with use of adapted grazing crops and liberal applications of fertilizers. Now, when farm labor is almost unobtainable, the wise counsel is far more applicable over the South and the humid areas of the country. Labor-saving methods of production and harvesting of forage have increased the trend toward storing feed, either green or cured, in self-feeding racks, bunks, silos, and cross-fenced pastures. Slightly more nutrients are required in cold weather to feed cattle without housing, but this is offset by the savings in labor and costs, and the health of livestock.

Three years' tests at the Middle Tennessee Experiment Station may illustrate the practice. Starting November 1 each fall, three groups of milking Jersey cows were used, divided as equally as possible with respect to previous production, lactation, age, and weight. Group I was the check group, barn-housed at night with access to a dry lot in the daytime. Group II was turned on early-planted Balbo rye and crimson clover pasture 3 to 5 hours daily, except during heavy rains or when ice or snow covered the ground. Group III had access to Balbo rye and button clover pasture continuously except at milking time and when the ground was covered with ice. They had access to a shed closed on the north and east sides. All cows were fed grain according to production plus 10 pounds of silage each, daily; and all the alfalfa-orchardgrass hay they would eat.

The pasture crops were planted by the middle of September each year following a sorghum crop on a disked seedbed. By the time of the first grazing, a good sod had formed that would support the cows in all but the worst weather. About 0.6 to 0.8 acre was available per cow, with no rotation of cows. Grazing continued until April in two years, or March 20 one year when permanent pasture was available.

As might have been predicted, the Group II on "rationed grazing" 3 to 5 hours daily produced the most milk, especially in the coldest winter. But surprisingly enough, Group III on continuous grazing and with limited shelter produced nearly as much in most months and outproduced the barn-housed cows of Group I. Averages of the three winter tests show that the cows on pasture 3 to 5 hours daily produced 33 per cent more milk, ate 31 per cent less hay, and returned 33 cents more per day above feed costs than the barn-fed cows. Those on pasture continuously averaged 10 per cent more milk, ate 54 per cent less hay, and returned 26 cents more per day above feed costs than the barn-fed cows.

Thus the average cow on both pasture systems returned $37.87 more above feed costs, maintained better pro-

Fig. 1. Group I, barn-housed and fed, with access to a dry lot in the daytime.

Fig. 3. Group III, on continuous grazing and with limited shelter.

Fig. 2. The dairy barn for housing groups I and II and for milking all cows.

Fig. 4. Shed used as shelter for Group III, open on the south and west.

duction and nearly the same weight, stayed cleaner, and required less labor and housing costs than those barn-fed. At actual feed costs, the average feed replacement value for pastures was $13.84 for Group II and $16.32 for Group III. The winter pasture apparently saved about one ton of hay per cow and made the dry feed more efficient by providing succulence, variety, and carotene. A little green feed (in winter) helps more than its nutrient content would indicate. Samples run one year indicated much higher vitamin A content for pasture cows' milk.

It was observed that there was not enough grazing available in either field after two months under the system used of stocking and continuous grazing. Therefore, at least one acre per cow is suggested or heavier fertilization and rotational grazing to insure a reserve of feed with favorable weather. While this experiment did not give all the answers, it indicated that Jersey cows at least require very little shelter under Tennessee conditions if some winter pasture and other feeds are available for economical milk production. It was noticeable, too, that Group III cows grew longer hair during the winter but came into the milking barn in cleaner condition. Except for the most

(*Turn to page* 49)

Fig. 1. Despite below-normal rain, the peanuts and the maize on this Rising Star, Texas, farm are doing well. That is because the farmer understands his soils and their treatment needs to prevent erosion and keep them productive. He keeps his soil in good condition by turning hairy vetch and rye into the surface. He windproofs his contoured rows of peanuts with strips of maize.

Conditioning Soils in the Southwest

By Richard M. Marshall

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THE manufacturers of soil conditioners, like those who make machinery for deep plowing, have stuck carefully to the truth in telling what their products do for soil. They make no extravagant claims about the benefits of mixing a chemical powder with the soil.

When new products appear on the market, however, just as when new drugs are announced for fighting human illness, we ourselves are inclined to exaggerate their benefits. This is especially true if they seem to offer a shortcut in solving a complex problem or a stubborn disease.

So convincing are some champions of these new farm measures that many a land operator could easily be lulled into the belief that by adopting them he would be doing all that was necessary to cure the long-standing ill that had befallen his land. The result is that further and, perhaps, less spectacular measures that would nurture his soil into lasting vigor are delayed and neglected.

Chemical products and mechanical operations such as deep plowing have a useful and important part to play in the agriculture of our nation as long as the operators of the land do not

make the mistake of accepting them as a permanent cure instead of a sort of aspirin that brings temporary relief. In the final analysis, there's no substitute for organic matter in the soil, and no amount of soil conditioner or deep plowing will provide this essential and fundamental need.

Soil conditioners can temporarily improve the structure of the soil so that we can get something to grow. They make the soil granular so that air and water can penetrate for the benefit of the plants, and if we do not use the temporary improvement to apply a permanent cure, we lose a good opportunity and have to repeat the expensive relief measure over and over again.

Deep plowing helps to prevent wind erosion on certain soils under certain conditions. But here again, if we don't get down to the slower and less spectacular business of putting organic matter into the soil or completely changing the use we're making of the land, we're going to be in worse trouble in the end than we were in the beginning.

Our best bet is to learn something about our soils so that we'll know how to use and treat them to make them safely productive at their maximum capacity indefinitely. Many farmers are doing that. More are joining their ranks each year as they are shown how to know their soils and what they can do.

The first thing that farmers learn about their land is that not all soils are alike. Soils vary just as plants and animals vary. In a single state you'll find several hundred different types of soil. It's not at all unusual to find 6 to 10 on a single farm.

Farmers in other sections might have taken false hope in a recently published article by Louis Bromfield, the famed novelist and conservationist. Mr. Bromfield wrote that on his Ohio farm he built 10 inches of topsoil in 10 years, a job that would have taken thousands of years for Nature to accomplish alone. Mr. Bromfield gave Nature a helping hand by speeding up the process.

Some scientists may question whether Mr. Bromfield built 10 inches of real topsoil in 10 years, but nevertheless he has done remarkable things on his farm in Ohio and in this case we can agree that he built at least the equivalent of genuine topsoil. A danger in

Fig. 2. Soils that gully like this can't produce clean-tilled crops for long. The soil will wash away, leaving only deep, unproductive gullies. It is better to leave or return such soils to profit-making grass.

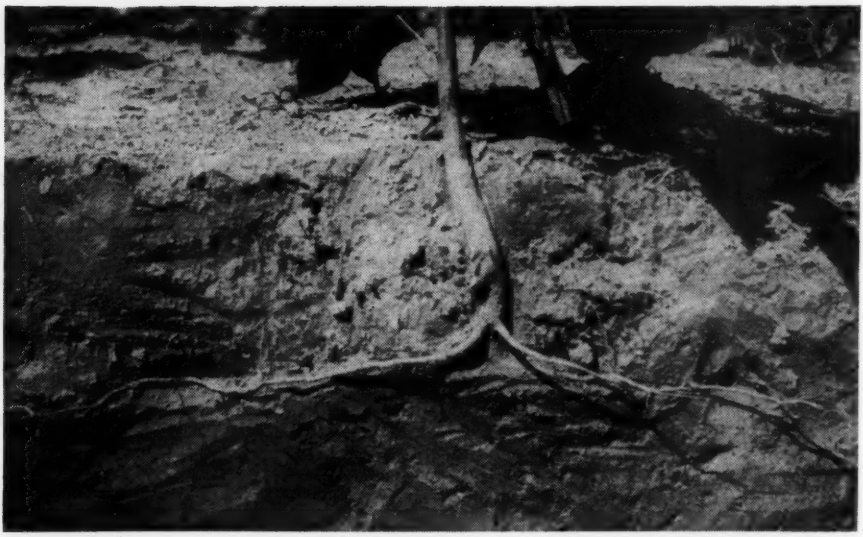

Fig. 3. This is what happens to cotton roots when they hit a plow pan. The hard layer of soil is caused generally by plowing at the same depth in the same place year after year and failure to get organic matter through this layer. Roots of crops cannot get through this layer to find nourishment farther down; hence crop yields suffer. Deep-rooted legumes and special tillage methods, including plowing the furrows at different depths from year to year prevent plow pan.

his statement is the inference that farmers all over the country can also build 10 inches of topsoil in 10 years.

There is scarcely a farm in the entire Southwest where that can be done. The soils of the Southwest differ greatly from the soils on Mr. Bromfield's farm. The soils in the Ohio region are of glacial origin and deep. Many of them are well-balanced in plant foods with loamy surface soil and open subsoil, allowing free movement of air and water. The soils are only moderately susceptible to erosion. Rainfall, averaging 35 to 40 inches annually, is not intense and is well distributed over the year. Winters are cold, summers warm to hot. The Ohio farming system provides for cover and soil-improving crops on the land most of the time.

In a large part of the Southwest the average annual rainfall runs between 25 and 35 inches. Much of it is of high intensity. There is a longer growing season with many more days of extremely hot, dry weather. Soil temperatures run as high as 140 degrees on the surface. Useful bacteria are killed by the heat. Organic matter is quickly burned out. Our farming system permits more clean-tilled row crops and we often lack the cover and protection of grasses. Prolonged drought made it impossible to get any kind of cover to grow on many Texas farms in 1952 and 1953.

We have land in the Cross Timbers area of Texas and Oklahoma that has been damaged badly by erosion. It already had two strikes against it when its owners began the application of a soil conservation program. It lacked the ability to bounce back quickly.

Soils of the Cross Timbers developed from ocean sediments that are ordinarily packed sand or sandy clay. They are usually low in organic matter and some plant foods, especially phosphorus. They are deep. Surface soils range from fine sandy loams to loose sands. Some subsoils are open, others are dense and compact. The soils are highly susceptible to both wind and water erosion.

A typical Cross Timbers farm near Dublin, Texas, lost practically all of

(*Turn to page* 50)

A Convenient Quick-test for Potash in Coastal Plains Soils

By Seton N. Edson

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IT is well known that aqueous solutions of cobaltinitrite salts are unstable on standing, and that alcoholic solutions commonly used for potassium soil tests are adversely affected by temperature changes. Recent attempts (1) to overcome these obstacles have been at least partially satisfactory; however, considerable improvement is still necessary for both stability of solution and convenience in temperature control.

Of the many modifications suggested for potash soil tests using the cobaltinitrite method, none appear to equal Olson's (3) recent technique for convenience, temperature control, and accuracy. In this method, a separate soil-extracting solution composed of 25% $NaNO_3$ is utilized. A portion of the soil extracted is treated with a quantity of isopropyl alcohol, a weighed amount of solid cobaltinitrite powder, shaken vigorously, and the amount of precipitated potassium noted after 5 minutes time. Excellent results are obtained with this method on the heavier soils high in exchangeable potassium. However, the following modifications were found necessary for the relatively light soils of the Coastal Plains. Where 120 pounds per acre [1] of available potassium was considered low for Kansas soils, this amount would be near optimum for many soils of the Coastal Plains. Elimination of a separate soil-extracting solution and the adaption of a universal soil-extracting solution, such as sodium acetate, would add greatly to the convenience of the solid cobaltinitrite method. Since results have shown that little if any error occurs with amounts of the powder ranging from 0.05 gm. to 0.15 gm., volume amounts may be substituted for weighed amounts, thus making the potash test truly a field method.

Probably few soil scientists have done more to correlate and standardize soil-extracting solutions than Hester (2). This is particularly true for Coastal Plains soils. Utilizing a slight modification of Hester's sodium acetate extracting solution, the following results were accomplished: (1) the solubility and stability of the solid cobaltinitrite method were established by adjusting the extract-alcohol ratio; (2) a specially constructed thin gauge metal "slip" (see Fig. 1) was calibrated to yield 0.05 gm. of solid cobaltinitrite powder; (3) with the soil extract, only the powder and alcohol are required to complete the soil test for potash; (4) a curve following Beer's law is readily established which is sensitive to less than 30 pounds per acre of potassium; and, (5) satisfactory correlation was established with Hester's procedure for potassium and with the solid cobaltinitrite method for most soil types of the Coastal Plains. Heavier soils gave higher results with the 25% $NaNO_3$ extracting solution.

[1] For convenience, amounts will be stated in pounds per acre—dilution factor of 6.

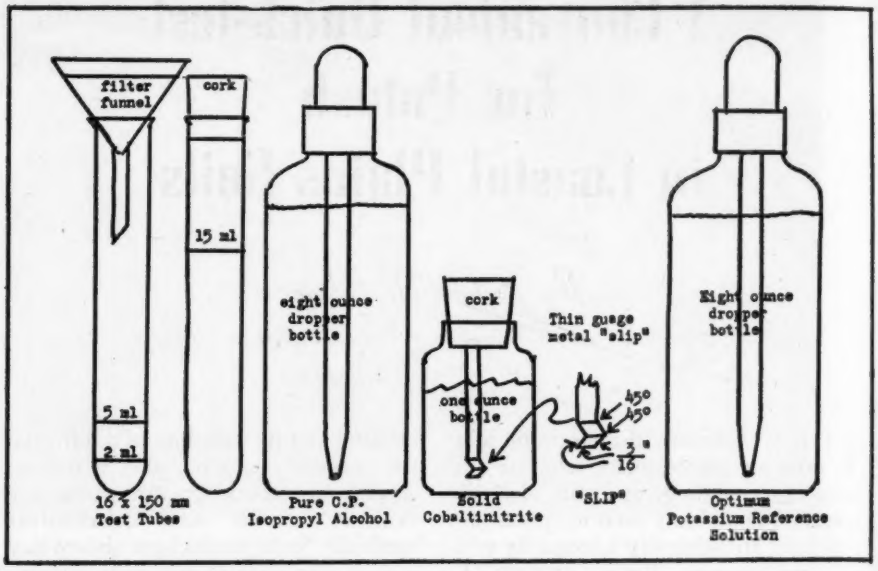


Figure 1. Complete equipment for conducting a potash test on Coastal Plains soils.

The procedure requires only the equipment and reagents shown in Fig. 1, plus the soil-extracting solution. To make the soil-extracting solution, dissolve 5 gms. of C.P. NaOH and 11 ml. of glacial acetic acid in a 1,000 ml. volumetric flask with some distilled water. Bring up to volume when the temperature of the solution appears near room temperature. Make up a large volume of potassium stock solution by dissolving 0.2 gm. of C.P. KCl in 2 liters of the extracting solution. For use, simply mix one part of the stock solution to one part of extracting solution which contains 157 pounds per acre of available potassium. Store in the 8-ounce dropper bottle as illustrated in Fig. 1.

The procedure is given as follows:

1. Place one level, well-packed measuring teaspoon (6-7 gms.) of a representative air-dry soil in the soil-extracting tube. Add the extracting solution to the 15 ml. mark. Stopper the tube and shake the contents for one full minute.

2. Filter the suspension through a Watman No. 1 filter paper and collect exactly 2 ml. in the marked tube. With the dropper, add alcohol to the 5 ml. mark. Swirl tube to mix.

3. Fill the "V" of the metal "slip" level full of solid cobaltinitrite by gently brushing against the top edge of the bottle on withdrawal. Add this amount to the alcohol mixture and immediately shake the tube vigorously for a few seconds. Allow the solution to stand for four minutes, shake again, and note the amount of yellow cloudiness formed.

4. Repeat this procedure starting from Step 3, and using the potassium reference solution. Compare the two tests and record the results as follows:

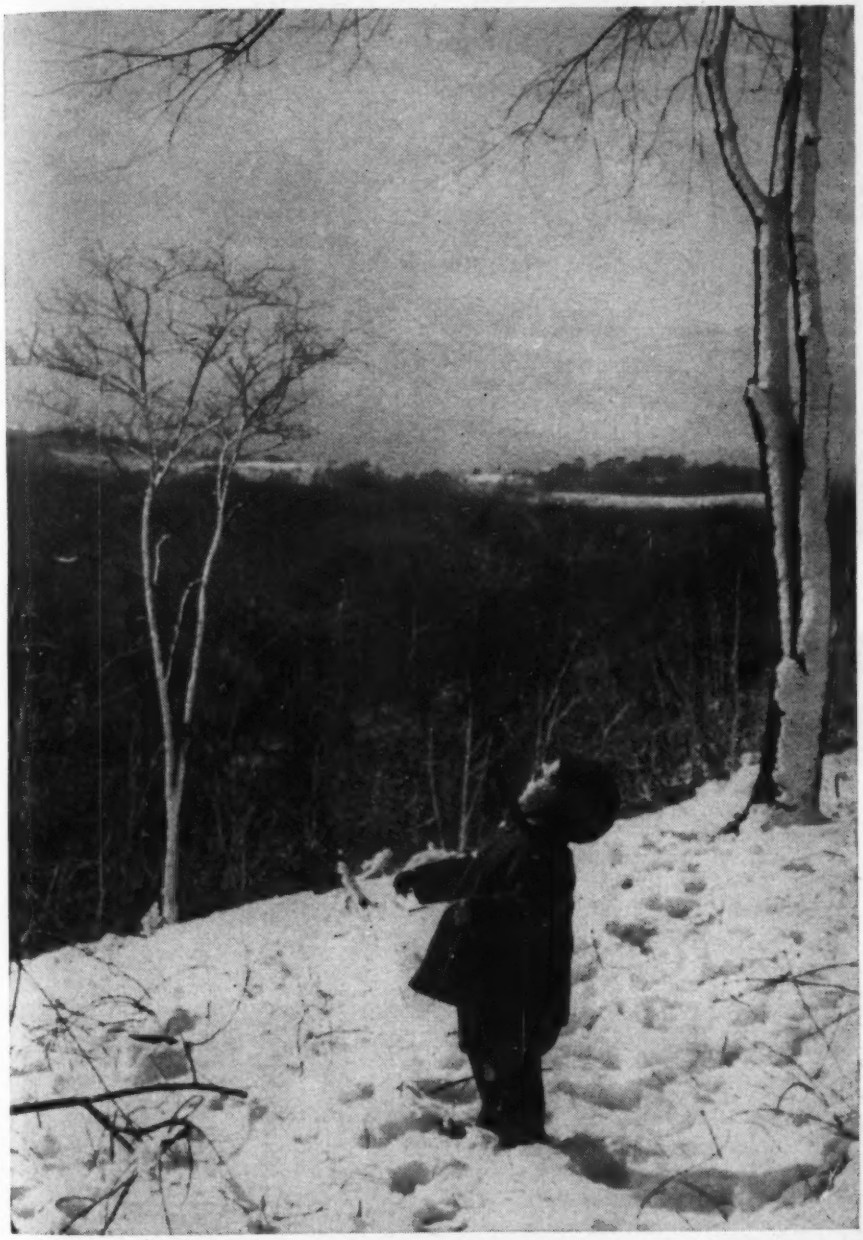
Yellow cloudiness denser than reference solution=High amounts of available potassium.

Yellow cloudiness the same as reference solution=Amounts near optimum for immediate crop needs.

Little or no yellow cloudiness in the soil test=Low amounts of available potassium.

(*Turn to page* 47)

PICTORIAL

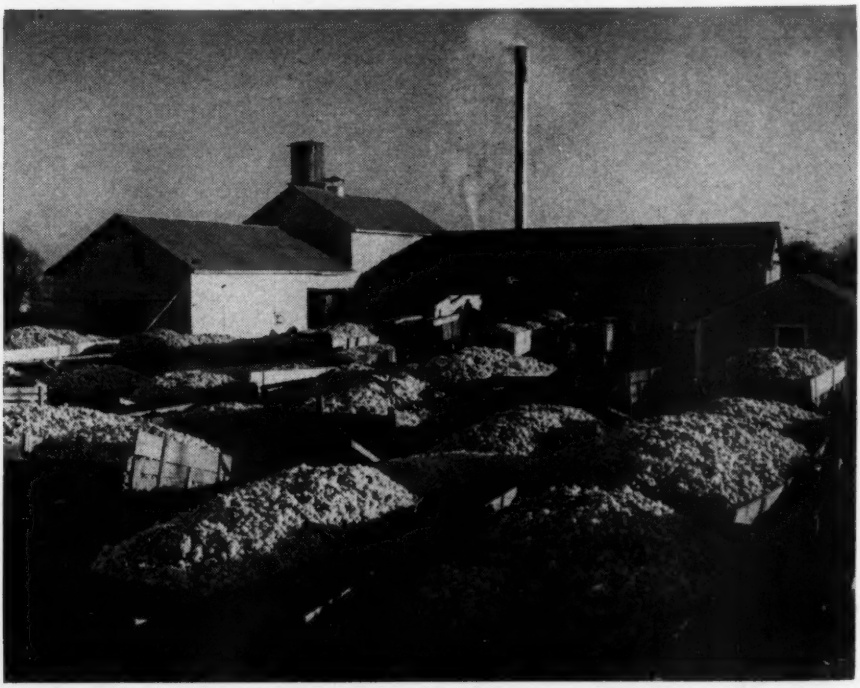


Who Frowed That?

Good grazing in the foothills.

Farm animals enjoy their leisure.

Big loads save on hauling.



The Editors Talk

Our Cover Picture

Is the available phosphate in your soils localized at or near the surface? Is it unevenly distributed throughout the topsoil with most of it on the plow-sole when broadcast and plowed under with a moldboard plow? Is it localized in deeply placed bands? Or, do you have a supply through the topsoil and below the plow depth? The cover page illustrates a method of getting this information in a few minutes in any field, or in any part of the field, at any time you wish to have it. It will help you in collecting and preparing representative samples of soil to be sent to a soil-testing laboratory for more detailed tests than can be obtained with this field diagnostic method. It will also guide you in planning for the efficient use and placement of phosphatic fertilizers for subsequent crops.

The procedure consists in obtaining a profile section of the soil in a sampler tube and testing small portions (one-eighth teaspoonful) of the soil at intervals of 2 to 3 inches from the surface to a depth of 12 to 14 inches. These soil samples are placed in sequence in the 1¼-inch depressions on a spot plate.

Fifteen drops of the No. 1 phosphate test solution, freshly prepared, are placed on each sample. Each sample is stirred with a clean glass rod, and the sediment allowed to settle until the solution covering each soil sample is fairly clear. Add three drops of a distilled water suspension of stannous oxalate to each sample. Jar the plate slightly until the stannous oxalate is diffused through the solution and a blue color, if any, develops uniformly. The intensity of the blue color around the rim of the concavity is compared with the chart, and the reading recorded in terms of very low, low, medium, high, or very high phosphate. Differences in these readings through the profile indicate relative supplies of available phosphate at different levels in the soil.

This information may serve as a guide in determining the placement of future applications of phosphatic fertilizers. It may also explain why subsequent soil samples sometimes fail to show the expected quantities of available phosphates, particularly when phosphates had previously been broadcast on the surface and not disced in or placed in bands deep in the soil. Such tests show that phosphates move very slowly in soils.

Tube A—samples on a spot plate show the phosphate localized in the surface when broadcast without discing or plowing the soil afterwards. This situation is found in many fertilized pastures. Such a condition may result in starved plants when the upper two inches of the soil are in a dry condition.

Tube B—tests show the irregular distribution of a broadcast application plowed under with a moldboard plow. Note that most of the phosphate is at or near the plow-sole. The surface soil was without sufficient phosphate to support a legume seeding.

Tube C—illustrates a broadcast application on a field for corn where banded phosphate fertilizer was placed deep the preceding year. The broadcast fertilizer

(500 lbs. 0-20-20) was later disced in deeply to provide an ample supply through the topsoil.

Tube D—samples show a uniformly high phosphate test from the surface to a depth of 12 inches. This distribution and deep placement are due to the decomposition of the roots of heavily fertilized sweet clover crops in two rotations. The taproots push phosphates into the soil below the plow depths.

Note: The soil-sampler tubes can be purchased from the Elano Corporation, Xenia, Ohio, and the Oliver Corporation, South Bend, Indiana. The phosphate test chemicals can be obtained from the Department of Agronomy, Purdue University, Lafayette, Indiana.

Five Grains of Corn

In things due our gratitude, we have come a long way since the Pilgrims more than 300 years ago offered thanks for the blessings bestowed upon them. It is recorded that arriving too late to plant crops, the Pilgrims spent such a hard first winter that the daily ration was five grains of corn.

The following year some 20 acres of Indian corn were planted, fertilized after the manner of the Indians with fish, of which there was a great abundance. The corn did well, and after harvest the Governor of the colony "sent four men on fowling, that so we might, after a special manner, rejoice together after we had gathered in the fruits of our labor."

Our society, in its intervening generations, has become increasingly industrialized and yet our homes and churches in town and city are decorated at Thanksgiving time with the products of the soil. "Plenty" is the keynote, and we have it. We can rejoice, but to the thoughtful in their rejoicing must also come remembrance of the less privileged and the wish that they too could share our blessings.

Noted in this connection is an editorial which appeared in the November 2 issue of the *Alabama Farm Bureau News,* from which we quote:

"Like as not, as we say grace and prepare to stuff ourselves into a stupor, we mentally cock a pious eye to heaven and utter a postscript: It ain't my fault, Lord, that two-thirds of the human race on this rich earth don't have enough to eat.

"We can always blame the situation on the Republicans or the Democrats, or the communists, while the economists argue over the merits of an economy of plenty and an economy of scarcity as a way to peace and prosperity. The plain fact is that our system of distribution has not kept up with the marvelous gains in production.

"Perhaps the editorial page, the soapbox, or the pulpit are not the places to go for a solution to the problem of hunger in a world of plenty. But at this Thanksgiving season we humbly suggest that while considering the hard facts of economic and military situations we should also give thought to the realities outlined by One who followed the psalmist:

> 'Wherefore ye shall do my statutes, and keep my judgments,
> and do them, and ye shall dwell in the land of safety.
> 'And the land shall yield her fruit, and ye shall eat your fill,
> and dwell therein in safety.—Lev. 25: 18-19.' "

'Tis said that for many generations, New England housewives, inviting family and guests to Thanksgiving, served five grains of corn in each plate as a reminder of past privations. Should we revive the custom to more forcefully include in our Thanksgiving a reminder of the underprivileged throughout the world?

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1927.....	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	45.9	128.0	214.0	124.0	188.0	16.50	43.40	....
1950.....	40.1	51.7	91.7	173.0	153.0	200.0	16.70	86.50	....
1951.....	37.9	51.2	163.0	306.0	168.0	211.0	19.50	69.30	....
1952									
November...	34.05	47.6	217.0	311.0	145.0	213.0	21.25	69.70	....
December....	31.71	49.6	199.0	362.0	150.0	212.0	21.65	68.50	....
1953									
January.....	29.79	46.2	206.0	386.0	148.0	210.0	21.65	65.30	....
February....	30.19	36.7	179.0	384.0	143.0	205.0	20.85	64.50	....
March.....	31.52	....	165.0	401.0	146.0	210.0	19.65	63.60	....
April.....	31.45	....	134.0	409.0	146.0	208.0	18.85	63.10	....
May.....	31.73	51.5	115.0	413.0	149.0	206.0	17.95	61.80	....
June.....	31.51	51.0	102.0	398.0	146.9	188.0	16.05	61.20	....
July.....	31.87	51.2	95.5	402.0	147.0	187.0	15.45	59.00	....
August.....	32.77	51.3	91.4	350.0	148.0	186.0	15.85	56.70	....
September...	33.09	57.6	98.9	264.0	150.0	192.0	16.15	51.50	....
October.....	32.46	52.6	89.7	233.0	134.0	194.0	16.45	52.40	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1927.....	163	207	146	124	132	135	87	154	127
1928.....	145	200	76	134	131	113	95	152	154
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	129
1931.....	46	82	66	83	50	44	73	40	115
1932.....	52	105	55	62	50	43	52	46	102
1933.....	82	130	118	79	81	84	68	57	91
1934.....	100	213	64	91	127	96	111	146	95
1935.....	90	184	85	80	102	94	63	135	119
1936.....	100	236	164	106	163	116	94	148	104
1937.....	68	204	76	89	81	109	74	87	110
1938.....	69	196	80	79	76	64	57	97	88
1939.....	73	154	100	84	88	78	67	94	91
1940.....	80	160	78	97	96	77	64	96	111
1941.....	137	264	116	105	117	107	82	211	129
1942.....	153	369	168	134	143	124	91	202	163
1943.....	160	405	188	235	174	154	125	231	245
1944.....	167	420	214	216	170	160	139	234	212
1945.....	181	366	205	232	198	170	127	227	207
1946.....	263	382	178	248	212	209	141	319	182
1947.....	257	380	232	248	336	259	148	381	226
1948.....	245	482	222	253	201	226	155	298	214
1949.....	231	459	184	244	193	213	139	192	201
1950.....	323	517	132	197	238	226	141	384	185
1951.....	306	512	233	349	262	239	164	307	239
1952									
November...	275	476	311	354	226	241	179	309	238
December....	256	496	286	412	234	240	182	304	256
1953									
January.....	240	462	296	440	231	238	182	290	237
February....	243	367	257	437	223	232	176	286	237
March.....	254	...	237	457	227	238	166	282	248
April.....	254	...	192	466	227	235	159	280	204
May.....	256	515	165	470	232	233	151	274	182
June.....	254	510	146	453	227	213	138	271	270
July.....	257	512	137	458	229	212	130	262	216
August.....	264	513	131	399	231	210	134	251	221
September...	267	576	142	301	234	217	136	228	159
October.....	262	526	129	265	209	219	139	232	175

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950	3.00	1.95	11.01	11.70	10.21	9.36
1951	3.16	1.97	13.20	10.92	10.18	10.09
1952						
November	3.34	2.07	13.31	11.24	10.32	9.71
December	3.34	2.26	13.20	11.24	9.95	9.17
1953						
January	3.34	2.28	13.25	11.24	8.43	8.05
February	3.34	2.28	13.21	11.24	7.75	7.28
March	3.34	2.28	12.69	11.24	7.16	6.56
April	3.34	2.28	11.75	11.24	6.07	6.00
May	3.34	2.28	10.34	11.24	6.23	6.14
June	3.34	2.28	10.61	11.26	6.62	6.31
July	3.34	2.28	10.34	11.15	6.75	6.14
August	3.34	2.28	10.14	10.95	7.53	6.68
September	3.09	2.28	9.82	11.04	7.51	6.91
October	3.09	2.25	9.73	11.24	7.96	7.75
	Index Numbers (1910-14 = 100)					
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950	112	68	315	331	303	266
1951	118	69	377	310	302	287
1952						
November	125	73	380	318	306	276
December	125	79	377	318	295	261
1953						
January	125	80	379	318	250	229
February	125	80	378	318	230	207
March	125	80	363	318	212	186
April	125	80	336	318	180	170
May	125	80	295	318	185	174
June	125	80	303	319	196	179
July	125	80	295	316	200	174
August	125	80	290	310	223	190
September	115	80	281	313	223	196
October	115	79	278	318	236	220

Wholesale Prices of Phosphates and Potash **

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950	.763	3.83	5.47	.371	.716	14.33	.195
1951	.813	3.98	5.47	.401	.780	15.25	.200
1952							
November	.860	3.98	5.47	.391	.768	14.72	.193
December	.860	3.98	5.47	.427	.827	16.00	.210
1953							
January	.860	3.98	5.47	.430	.827	16.00	.210
February	.860	3.98	5.47	.430	.827	16.00	.210
March	.860	4.22	5.47	.430	.827	16.00	.210
April	.860	4.28	....	.430	.827	16.00	.210
May	.860	4.28	....	.430	.827	16.00	.210
June	.860	4.28	....	.361	.708	13.44	.176
July	.895	4.28	....	.396	.768	14.72	.193
August	.895	....	....	.396	.768	14.72	.193
September	.895	....	....	.396	.768	14.72	.193
October	.895	....	....	.396	.768	14.72	.193
			Index Numbers (1910-14 = 100)				
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950	142	106	112	68	75	59	83
1951	152	110	112	72	82	63	83
1952							
November	160	110	112	70	81	61	82
December	160	110	112	75	87	66	85
1953							
January	160	110	112	76	87	66	85
February	160	110	112	76	87	66	85
March	160	117	112	76	87	66	85
April	160	119	...	76	87	66	85
May	160	119	...	76	87	66	85
June	160	119	...	66	74	56	80
July	167	119	...	71	81	61	82
August	167	...	...	71	81	61	82
September	167	...	...	71	81	61	82
October	167	...	...	71	81	61	82

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and all Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1927.....	141	148	139	116	89	150	100	94
1928.....	149	152	141	121	87	177	108	97
1929.....	148	150	139	114	79	146	114	97
1930.....	125	140	126	105	72	131	101	99
1931.....	87	119	107	83	62	83	90	99
1932.....	65	102	95	71	46	48	85	99
1933.....	70	104	96	70	45	71	81	95
1934.....	90	118	109	72	47	90	91	72
1935.....	109	123	117	70	45	97	92	63
1936.....	114	123	118	73	47	107	89	69
1937.....	122	130	126	81	50	129	95	75
1938.....	97	122	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	123	130	127	86	56	130	102	77
1942.....	158	149	144	93	57	161	112	77
1943.....	192	165	151	94	57	160	117	77
1944.....	196	174	152	96	57	174	120	76
1945.....	206	180	154	97	57	175	121	76
1946.....	234	197	177	107	62	240	125	75
1947.....	275	231	222	130	74	362	139	72
1948.....	285	250	241	134	89	314	143	70
1949.....	249	240	226	137	99	319	144	70
1950.....	256	246	236	132	89	314	142	72
1951.....	302	271	263	139	93	331	152	76
1952								
November.	277	268	248	144	98	336	160	74
December..	269	267	246	146	101	329	160	79
1953								
January...	267	267	246	144	102	307	160	80
February..	263	264	246	142	102	296	160	80
March....	264	265	248	141	102	282	160	80
April.....	259	264	246	139	102	256	160	80
May.....	261	264	247	137	102	245	160	80
June.....	259	260	246	135	102	253	160	70
July.....	259	261	248	138	102	252	167	75
August....	258	262	249	139	102	261	167	75
September.	256	259	249	137	97	258	167	75
October...	250	258	247	137	96	265	167	75

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] **Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.**

[2] **All potash salts now quoted F.O.B. mines only; manure salts since June 1941, other carriers since June 1947.**

** **The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Effect of Kind of Phosphate Fertilizer and Method of Placement on Phosphorus Absorption by Crops Grown on Arizona Calcareous Soil," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 128, June 1953, W. H. Fuller.

"Fertilizing Flue-Cured Tobacco," Agr. Exp. Sta., Tifton, Ga., Mimeo. 16, Rev. July 1953, I. Neas.

"1953 Cooperative Wheat Fertilization Plot Yields, Fertilizers, Broadcast and Drilled, and Nitrogen, Fall and Spring Applied, Compared to Soil Experiment Field Yields in Same Vicinity," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Mimeo., Aug. 1953, P. E. Johnson.

"The Illinois Soil Fertility Team," Agr. Ext. Serv., Univ. of Ill., Urbana, Ill., AG 1565, Mar. 1953.

"Fertilizers, Fertilizer Materials, and Rock Phosphate Sold in Illinois, January 1, 1953 to June 30, 1953," Agr. Exp. Sta., Univ. of Ill., Urbana Ill., AG 1592, Sept. 1953, T. Kurtz and N. G. Pieper.

"Liquid Fertilizers, Questions and Answers," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Cir. 394 Rev. Apr. 1953, A. J. Ohlrogge and G. F. Warren.

"Commercial Fertilizers in Kentucky, 1952, Including a Report on Official Fertilizer Samples Analyzed July-Dec., 1952," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Bul. 104, June 1953.

"Anhydrous Ammonia and Nitrogen Solutions," Agr. Ext. Serv., Univ. of Md., College Park, Md., Fact Sheet 68, F. L. Bentz, Jr.

"Lime Program Must Accompany High Rates of Ammonium Nitrate, Anhydrous Ammonia, and Ammonium Sulphate on Row Crops," Agr. Exp. Sta., Miss. State College, State College, Miss., Inf. Sht. 481, Apr. 1953, U. S. Jones and C. D. Hoover

"Missouri Fertilizer Tonnage Report, Jan. 1 to June 30, 1953," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo.

"Potassium-Bearing Minerals as Soil Treatments," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 510, Oct. 1952, E. R. Graham and W. A. Albrecht.

"Inspection of Fertilizers Made for the State Department of Agriculture and Conservation," Agr. Exp. Sta., Univ. of R. I., Kingston, R. I., Ann. Fert. Cir., Jan. 1953, R. W. Gilbert and C. E. Olney.

"Effect of Fertilizer Treatments on Yield and on Earworm Damage of Fall-Planted Sweet Corn," Agr. Exp. Sta., Texas A & M College, College Station, Texas, Prog. Rpt. 1581, May 9, 1953, H. W. Gausman, G. P. Wene, and N. J. Cain.

"Determining Profitable Use of Fertilizer," USDA, Wash., D. C., F. M. 105, June 1953, D. B. Ibach and S. W. Mendum.

"Economic Analysis of Alfalfa Yield Response to Phosphate Fertilizer at Three Locations in the West," USDA, Wash., D. C., F. M. 104, June 1953, J. L. Pascal.

Soils

"Sweet Corn Production on the Sandy Soils of the Florida Lower East Coast," Agr. Exp. Sta., Univ. of Florida, Gainesville, Fla., Bul. 520, July 1953, W. A. Hills, N. C. Hayslip, J. F. Darby, and W. T. Forsee, Jr.

"Cover Crops, Green Manures, and Mulches in Management and Conservation of the Soil," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, Hawaii, Cir. 337, Aug. 1953, Z. C. Foster.

"Evaluating Salt Content of Irrigation Water and Plant Tolerance," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, Hawaii, Cir. 338, Aug. 1953, Z. C. Foster.

"Soil Associations of Pawnee County, Oklahoma," Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., Misc. Pub. MP-28, Dec. 1952, H. M. Galloway, H. F. Murphy, and F. Gray.

"The Soils of the Island of Vieques," Agr. Exp. Sta., Univ. of Puerto Rico, Rio Piedras, Puerto Rico, Bul. 108, March 1953, M. A. Lugo-López, J. A. Bonnett, and J. García.

"Moisture Relationships of Puerto Rican Soils," Agr. Exp. Sta., Univ. of Puerto Rico, Rio Piedras, Puerto Rico, Tech. Paper 9, Jan. 1953, M. A. Lugo-López.

"Some Characteristics of the Pullman Soils on the Amarillo Experiment Station," Agr. Exp. Sta., Texas A & M College, College Station, Texas, Misc. Pub. 97, June 1953, J. R.

Coover, C. E. Van Doren, and C. J. Whitfield.

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"1954 Agricultural Conservation Program National Bulletin," USDA, Wash., D. C., ACP-1954, Aug. 1953.

Crops

"Arkwin, A Disease-Resistant Oat and Comparisons of Small Grains as Winter Forage," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 533, Apr. 1953, H. R. Rosen, W. J. Wiser, and J. O. York.

"Factors Affecting Winter Injury to Peach Trees," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 536, June 1953, J. R. Cooper.

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"Pastures for the Coastal Plain of Georgia," Agr. Exp. Sta., Univ. of Ga., Experiment, Ga., Bul. 27, June 1942, Rev. June 1952, J. L. Stephens.

"Growing Carrot Seed in Idaho," Univ. of Idaho, Agr. Exp. Sta., Moscow, Idaho, Bul. 294, Apr. 1953, D. F. Franklin.

"Strawberries for Home and Market," Agr. Ext. Serv., Purdue Univ., Lafayette, Ind., Ext. Leaf. 353, 1953, W. B. Ward and R. L. Klackle.

"Gladiolus for the Amateur," Agr. Ext. Serv., Purdue Univ., Lafayette, Ind., Ext. Bul. 381, 1953, C. E. Hoxsie.

"Louisiana Okra," Agr. Ext. Serv., La. State Univ., Baton Rouge, La., Ext. Pub. 1141, Apr. 1953, W. R. Wilson, J. A. Cox, and J. Montelaro.

"Chemical Composition of Grasses and Legumes in Maine," Agr. Exp. Sta., Univ. of Me., Orono, Me., Bul. 513, May 1953, B. E. Plummer, Jr.

"Extension Work and People, 1952," Agr. Ext. Serv., Univ. of Md., College Park, Md., 38th Annual Report.

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"The Performance of Hybrid Corn in 1952," Agr. Exp. Sta., Univ. of Md., College Park, Md., Misc. Pub. 157, Feb. 1953, R. G. Rothgeb.

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"Microbiology Studies of Stubble Mulching," Agr. Exp. Sta., Univ. of Neb., Lincoln, Neb., Bul. 417, March 1953, T. M. McCalla.

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"Hybrid Corn Field Trials," Agr. Exp. Sta., N. D. Agr. College, Fargo, N. D., Agron. Mimeo. Cir. 86A, Jan. 1953.

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"Re-establishing the Peach Orchard," Agr. Exp. Sta., Penna. State College, State College, Penna., Prog. Rpt. 106, July 1953, F. N. Hewetson.

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Texas, Prog. Rpt. 1596, Aug. 3, 1953, R. T. Correa.

"Small Grain Forage Tests at the Winter Garden Station, 1952-53," Agr. Exp. Sta., Texas A & M College, College Station, Texas, Prog. Rpt. 1598, Aug. 8, 1953, C. S. Hoveland.

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"Permanent Hayfields Without Plowing," Agr. Exp. Sta., Univ. of Vt., Burlington, Vt., Bul. 572, June 1953, A. R. Midgley and K. E. Varney.

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"Lawns," Ext. Serv., State College of Wash., Pullman, Wash., Ext. Bul. 482, Sept. 1953, K. J. Morrison, C. B. Harston, H. H. Wolfe, D. H. Brannon, and M. R. Harris.

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"Chrysanthemums for the Home," USDA, Bur. of Plant Industry, Beltsville, Md., S. L. Emsweller, W. D. McClellan, and P. Brierley.

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Economics

"Orange County Valencia Production Cost Analysis, 1952, 27th Annual Summary," Agr. Ext. Serv., Univ. of Calif., Berkeley, Calif., Mimeo., July 1953.

"Colorado Agricultural Statistics 1951," Colo. Dept. of Agr., Denver, Colo., Vol. 1, No. 3, Jan. 1953.

"Factors in the 1953 Market Situation for Connecticut Valley Types of Cigar Tobacco," Agr. Exp. Sta., Univ. of Conn., Storrs, Conn., INF. 51, Sept. 1953, A. W. Dewey.

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"Costs and Returns on Dry-Land Wheat Farms, Wasco County, Oregon, 1951," Agr. Exp. Sta., Oregon State College, Corvallis, Ore., Cir. 529, May 1953, G. W. Kuhlman.

"Production Goals for Crop Enterprise Projects in Vocational Agriculture," Agr. Exp. Sta., Pa. State College, State College, Pa., Bul. 570, July 1953, J. O. McCurdy, N. K. Hoover, and H. S. Brunner.

"Production Practices for Irrigated Crops on the High Plains," Agr. Exp. Sta., Texas A & M College, College Station, Texas, Bul. 763, June 1953, A. C. Magee, C. A. Bonnen, W. C. McArthur, and W. F. Hughes.

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"United States Farm Products in Foreign Trade," USDA, Wash., D. C., Stat. Bul. 112, 1953.

"Farming Alternatives for Potato Growers on the Eastern Shore, Virginia-Maryland," USDA, Wash., D. C. Agr. Inf. Bul. 102, June 1953, E. G. Strand.

"Low Production Farms, USDA, Wash., D. C., Agr. Inf. Bul. 108, June 1953, J. V. McElveen and K. L. Bachman.

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The Importance of Legumes . . .

(*From page* 16)

the nitrogen for high production in pasture forages.

The influence of clover in the mixture on the yield of pasture, in terms of TDN obtained by cows from grazing, is shown in Table III.

In this experiment an old established bluegrass sod and an old established orchard grass sod were divided, so that half of each could be treated by renovation and the other half could be maintained as a check. Both the renovated and unrenovated pastures were grazed rotationally. The pastures all received the same manurial, lime, and fertilizer treatment. The renovation treatment—tearing up the sod—was done to open up the sod and destroy part of it. Legumes were then seeded to increase the legume population.

The data in Table III are for the second to the fifth years, inclusive, following the year of renovation treatment (the first year, being only a partial grazing season following renovation, was excluded). It can be observed that each year there was a material increase in the production of nutrients by the renovated pasture as compared to the check pasture. Over the 4-year period, the average yearly increase was 48 per cent for the renovated bluegrass sod and 44 per cent for the renovated orchard grass sod.

While there was a considerable percentage of legumes in the unrenovated sods, the percentage of legumes (largely ladino clover) in the renovated pastures was in each case higher each year than in the unrenovated pastures. It is also apparent in both the renovated and the unrenovated pastures that as the legume content decreased in succeeding years so did the yield of TDN obtained from grazing. While the unrenovated pastures in this experiment were rather high yielding, the introduction of legumes very materially boosted the yield to the equivalent of from 2.5 to about 4 tons of alfalfa hay per acre.

I indicated that the inclusion of legumes in the pasture mixture not only increased the protein content of the mixed forage but also the protein content of the grass grown in association with the legumes, as well as the total yield of protein per acre. This is shown in Table IV.

In this experiment, orchard grass and tall fescue were each grown alone and in combination with ladino clover. The first point of importance in these

TABLE II.—COMPARATIVE EFFECTS OF LADINO CLOVER AND COMMERCIAL NITROGEN ON PRODUCTION OF PASTURE HERBAGE[1]

Crop or crop production[2]	Dry matter yield per acre	Protein content	Protein yield per acre
	Pounds	*Per cent*	*Pounds*
Orchard grass with 160 pounds of nitrogen per acre	7,282	16.0	1,067
Orchard grass with ladino clover	7,981	16.5	1,174
Tall fescue with 160 pounds of nitrogen per acre	6,864	15.2	1,066
Tall fescue with ladino clover	7,671	19.5	1,374

[1] Unpublished data obtained from the Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture.
[2] Weed free.

TABLE III.—ASSOCIATION BETWEEN TDN YIELD OF PASTURE AND THE PERCENTAGE OF LEGUMES [1]

Year following renovation	Basic bluegrass sod				Basic orchard grass sod			
	Renovated [2]		Unrenovated		Renovated [2]		Unrenovated	
	Legumes	TDN yield	Legumes	TDN yield	Legumes	TDN yield	Legumes	TDN yield
	Per cent	*Pounds per acre*	*Per cent*	*Pounds per acre*	*Per cent*	*Pounds per acre*	*Per cent*	*Pounds per acre*
Second	37	4,414	22	2,911	37	3,896	20	2,927
Third	32	4,001	18	2,951	24	3,932	18	3,215
Fourth	18	3,995	10	2,403	17	4,288	12	2,682
Fifth	12	3,190	6	2,253	13	4,404	10	2,633
Average	25	3,899	12	2,629	23	4,130	15	2,864
Average yearly increase by renovated pastures (%)		48	.....	.....	.....	44	.....	.....

[1] Data taken in part from U. S. Dept. Agr., Bur. Dairy Indus. BDI-Inf-97, issued in 1950.
[2] Renovation treatment consisted of tearing up the old sod by disking in the fall and spring, and spring seeding 8 pounds of alfalfa, 3 pounds of red clover, and 1 pound of ladino clover per acre. Renovated and check pastures each received 10 tons of manure, 1 ton of limestone, and 500 pounds of 0-14-14 fertilizer at the time of renovation.

data is that, while the yield of ladino clover was lower when it was grown in association with either of the grasses than when it was grown by itself, ladino clover grown in association with the grasses caused a very marked increase in the yield of the grasses as compared to that obtained when the grasses were grown alone. This resulted in a greater total yield of dry matter for the grass-clover combinations. Secondly, it will be noted that

TABLE IV.—THE INFLUENCE OF LADINO CLOVER ON YIELD AND PROTEIN CONTENT OF MIXED PASTURE HERBAGE [1]

Crop or crop combination [2]	Dry matter yield per acre	Protein content	Protein yield per acre
	Pounds	*Per cent*	*Pounds*
Orchard grass alone	2,392	12.3	231
Ladino clover alone	3,852	27.0	1,026
Orchard grass and ladino clover (when grown together)	7,981	16.5	1,174
Orchard grass (when grown with ladino clover)	6,575	14.3	815
Ladino clover (when grown with orchard grass)	1,406	27.0	359
Tall fescue alone	2,944	12.0	303
Ladino clover alone	3,852	27.0	1,026
Tall fescue and ladino clover (when grown together)	7,671	19.5	1,374
Tall fescue (when grown with ladino clover)	5,263	15.8	762
Ladino clover (when grown with tall fescue)	2,408	27.4	612

[1] Unpublished data obtained from the Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture.
[2] Weed free.

Fig. 3. This alfalfa-brome pasture provides an abundance of highly nutritious feed for this herd of Hereford steers. The experts tell us that legumes in association with grasses markedly increase yield and quality of herbage. When the percentage of legumes is maintained between 20 and 40 per cent, the danger of bloat is not very great.

while the protein content of the clover was about the same, whether grown alone or in combination with grasses, the protein content of the grasses themselves was increased considerably when grown in association with ladino clover. Also, the yield of protein per acre was increased in the grass-clover mixtures. The use of legumes in these mixtures, therefore, increased the protein content of the herbage so that it should much more adequately provide the total protein needs of grazing animals.

Legumes are known to be considerably higher in calcium and slightly higher in phosphorus and potassium than are grasses. Data to illustrate this point with bluegrass and white clover are summarized in Table V. These data also indicate that when bluegrass and white clover are grown together, both species have a higher calcium, phosphorus, and potassium content than bluegrass grown alone.

Legumes in the pasture mixture are helpful in maintaining a higher yield of forages and a higher protein, calcium, and phosphorus content in the

TABLE V.—MINERAL COMPOSITION OF BLUEGRASS AND WHITE CLOVER GROWING IN ASSOCIATION AND OF BLUEGRASS GROWING ALONE [1]

Crop	Mineral composition		
	Calcium	Phosphorus	Potassium
	Per cent	*Per cent*	*Per cent*
Bluegrass (when growing with white clover)	0.57	0.44	2.92
White clover (when growing with bluegrass)	1.56	.43	4.03
Bluegrass growing alone	.49	.37	2.46

[1] Adapted from Table II of The Place of Legumes in Pasture Production, by E. N. Fergus in Jour. Amer. Soc. Agron. 27(5): 367-373. 1935.

forages throughout the grazing season. It has been our experience, both with renovated permanent pastures and with crop-rotation short-ley pastures, that where there is a good population of legumes in the mixture there is a more even distribution of herbage available for grazing throughout the season. This is brought about by the fact that the legumes remain more productive than the grasses during the hotter, drier parts of the summer. Because of this, the protein, mineral, and carotene content of the herbage remains somewhat higher during the critical time.

Hope for Minimizing the Danger of Bloat

It will be noted, particularly from Table III, that it was possible to bring about a marked increase in yield of herbages and thereby high-yielding pasture when the pasture contained from 20 to 40 per cent of legumes. When the percentage of legumes is no higher than this, the danger of bloat apparently is not very great. It is also known that alfalfa alone, or alfalfa with varying amounts of bromegrass, produces high yields. The development of pasture with legumes in the mixture, often results in herbage having a very high legume content and at times almost pure legumes. When this condition exists, the danger of bloat is considerably increased. Under these conditions farmers must exercise considerably more care in grazing management, and they will have to watch their cows more closely. We hope that through research our agronomy and soil specialists will work out improved ways to develop pastures that will contain perhaps up to 50 per cent of legumes in the grass-legume mixture and that will maintain this desirable plant-population relationship over a considerable period of time.

Sunshine Is Our Life

(*From page* 12)

a modern factory. Just as the skilled workmen do their particular jobs along the assembly line so are the enzymes and other catalysts doing their creative work as the raw material moves along. Something is added and something is taken away. Such elements as nitrogen, calcium, phosphorus, iron, sulphur, and others are added as needed while excessive amounts of oxygen, hydrogen, carbon, and others are given off. Molecules of one substance are turned into molecules of other substances. The energy gathered in the green leaves is being added tending to make the resulting molecules more complex. Thus a plant can make any substance for which it has the creative power, as determined by its enzyme system or the skilled workmen along its assembly line. The simple sugar that was formed in the leaf becomes bark, fibre, root, leaf, flower, starch, complex sugar, oil, protein, acid color, fragrance, some vitamins, and the plant's own antibiotics. What wonders a plant can perform if its sugar bowl is kept well filled.

Sunshine is our most abundant and most essential natural resource. It is inexhaustible and it is free for the taking. What a tiny bit of sunshine is intercepted by the earth and what a small part of that is made use of! Our coal mines and oil wells will supply energy for heat and power for generations. This energy was trapped by plants millions or perhaps billions of years ago when man did not exist. We need not worry about a lack of heat and power but there are no such buried reserves of food. The production of food is a current process. We eat very little food that is a few years old. We depend each growing season on the plant's ability to trap and pack the energy from the sun, in the form of simple sugar from which all our foods are de-

rived. Sunshine is, therefore, our bread, butter, meat, fruit, vegetables, or anything else that gives us sustenance.

Just as the gasoline we use in our automobile is the most necessary item to keep it running, so is the energy in our food the most necessary item in keeping us alive. We do need the different elements, the building blocks, to grow and maintain our bodies. We eat different foods, some from different areas, which provide the needed elements as well as some complex organic structures, as the vitamins, which our bodies lack the catalysts to synthesize. However, the elements that make up our bodies are about us in very large quantities as the earth is the storehouse of all the materials our bodies are made of. There is no apparent shortage of such materials although they may not all be in one place.

Population increases need not be limited by the number of acres under cultivation but by the efficiency of leaves of plants in locking the energy from the sun. Man's ingenuity to help the plants store more of this energy will be put to a test. We will need more efficient crops, more and better plant foods applied as often as needed, and a very dependable system of supplying soil moisture. With these things under control we would hear more about such high yields per acre as 1,000 bushels of potatoes, 200 bushels corn, and 10 tons of cherries and less about the poorly nourished people of the world and their attendant evil, Communism.

Boron—Important to Crops

(*From page* 19)

The close relationship between the incidence of boron deficiency and potassium concentration indicates that, in some manner, these two elements jointly affect vital processes in the plant. The work of Reed (15), MacVicar and Burris (14), and Stewart and Preston (21) may provide a possible explanation. For example, the action of low boron concentration accompanied by high potassium concentration in the active plant cells may increase the polyphenol oxidase activity of the cells, which is not accompanied by a corresponding increase in the reduction process. This results in an unbalanced condition in these cells due to a disruption of normal cell metabolism. Death of the cells results. This may possibly account for the dark brown spots appearing in tissues of boron-deficient crops, such as radishes, beets, turnips, and cauliflower.

Cowperthwaite also found that increasing the concentration of boron in the substrate alleviated the symptoms of calcium deficiency found in the upper leaf blades of plants at the lowest level of calcium nutrition. In other words, boron tended to bring about a more efficient utilization of the small amount of calcium present in such tissues. In this connection Reeve and Shive (16) found that as the calcium content of a nutrient solution was increased, more boron was required to prevent boron deficiency in the plant. More boron could be added to the solution without the development of symptoms of boron toxicity. From Cowperthwaite's work there also appeared to be an antagonistic effect between boron and calcium with respect to the permeability of roots to ions. High calcium concentrations tended to decrease this permeability.

Weed (25) studied the effects of different milliequivalent anion proportions in nutrient solutions on the boron nutrition of the tomato, using deficient, adequate, and toxic levels of boron. Earlier work by Wadleigh and Shive (22) and Briggs (10) had shown that boron deficiency in cotton and nasturtiums is associated with the accumulation of both ammonia nitrogen and

carbohydrates, with the progressive degeneracy of the protoplasmic proteins. Since Beckenback et al (1) showed that the utilization of carbohydrates is intimately connected with the supply of nitrates, phosphates, sulfates, and potassium, the effect of boron on plant metabolism may be connected with these ions. At low boron concentrations in the substrate, Weed found that the severity of boron-deficiency symptoms was increased at high nitrate concentrations. This was in part due to the fact that plants were usually larger with high nitrate concentrations and consequently had a greater total requirement for boron. Rapid growth was associated with increase in the activity of the meristematic tissue and formation of new cells. Dennis (12) in 1948 showed that boron is not readily translocated from one portion of the plant to another, and must be continually supplied in adequate amounts to actively growing plant tissues to maintain normal growth. As early as 1939, Brandenburg (6) pointed out that absorbed boron was mostly fixed in the leaves and that its translocation from then on was very difficult. He also showed that the boron requirement of plants rises in proportion to the amount of potassium and nitrogen supplied.

Weed also showed that at any given nitrate level, boron-deficiency symptoms were less severe if the phosphate concentration was high. In this connection, White-Stevens and Wessels (26), working with rutabagas, found that when the nitrogen level was low, additions of phosphates decreased boron deficiency. But when the nitrogen level was high, phosphates increased the boron deficiency. Beckenback (2) suggested that phosphate and borate ions may function as essential juice buffers or in precipitating excess cations which form relatively insoluble salts with these anions.

At high boron levels (5 ppm. in substrate), Weed found that the severity of boron toxicity symptoms increased as the nitrate was increased in the nutrient solution and was correlated with the boron content of the lower blades of the plant tissue. Such tissue contained between 210 and 680 ppm. boron. There was also correlation between the severity of boron-deficiency symptoms and the concentration of boron in the tissue. Thus if the upper blades of the tomato plants contained less than 12 ppm. boron, the tomatoes showed signs of boron deficiency.

Plant root requirements for boron have also been studied. Haynes and Robbins (13) showed that the presence of both boron and calcium in the entire root environment was necessary for the maintenance of completely healthy roots. Furthermore, in order for root systems to extend into new soil zones, these zones must be adequately supplied with boron, calcium, and moisture.

Further work is in progress at this Station on the relationship of boron to the organic acids in plants. As stated previously, present-day research on boron now leans toward fundamental studies on the function of the element in the plant, and the mechanisms involved in its fixation and availability in soils. Further work is needed on the boron requirements of many crops grown on different soil series, and on methods, rates and times of application. For practical agriculture, however, so-called boron-deficiency diseases can be overcome at slight cost by the use of relatively small amounts of borax.

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She Had to Be Sure

A fussy woman in a fussy restaurant directed a fussy French waiter thusly: "I'll have caviar, too. And, waiter, I must have imported caviar."

The waiter merely drooped his little black mustache and arched his eyebrows wisely.

"I want you to be sure I have imported caviar, instead of the domestic," the lady insisted again, then added: "Because I can't tell the difference."

Useless

Uncle Mose was an inveterate horse trader and something of a wit. Once, after swapping a disreputable looking nag, he said, "Now, mister, I'll be honest an' tell you dat hoss has jes' two faults."

"What are they?" asked the other.

"Well, ef'n he gits out in the field he's the hardest hoss to ketch you ever seed, an' when you ketches him, he ain't wuth it!"

A Convenient Quick-test

(*From page* 26)

Experimental and Discussion

The procedure presented was tested for stability and accuracy using a Hellege-Diller photoelectric colorimeter employing a 610 mu. filter. Amounts of KCl were dissolved in the extracting solution, a curve plotted, and four separate analyses for potassium conducted. The results obtained are given in Table I.

TABLE I.—P.P.M. OF POTASSIUM IN STANDARD SOLUTION COMPARED WITH AMOUNTS DETERMINED BY RAPID TEST

p.p.m. of K in standard solution	Range in p.p.m. of K in solution using metal "slip" for volume amounts of solid cobaltinitrite
5.0	4.5– 5.8
15.0	14.2–15.4
25.0	24.2–26.2
37.5	36.7–38.5
50.0	48.5–51.0

The procedure was further tested against 11 Coastal Plains soil types (Table II) taken from both cultivated and fallow fields. Results of tests by the Olson and Hester methods and the modified rapid test proposed are compared in Table II.

The results obtained indicate that satisfactory volume amounts of cobaltinitrite powder may be used for rapid potash soil tests. The sodium acetate extracting solution gave excellent results when used in the proportion of two volumes of soil extract to three volumes of isopropyl alcohol. This was true even for amounts as little as 30 pounds per acre of potassium.

For all practical purposes, amounts of potassium found in all soil types were in satisfactory agreement for the three methods employed, with the exception of the heavier Ducker and Red Bay soils. These two soils gave high quantities of potassium when extracted with 25% $NaNO_3$.

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TABLE II.—POUNDS PER ACRE OF K FOUND BY DIFFERENT SOIL TESTS

Soil types	Olson method	Hester method	Modified solid cobaltinitrite method using "slip" and sodium acetate extractant
Arredondo l.f.s.	330	340	350
Portsmouth f.s.l.	317	340	340
Leon f.s.	245	255	257
Scranton l.f.s.	135	144	140
Ducker loam	300	215	200
Lakeland f.s.	210	220	225
Red Bay s.l.	287	220	200
Leon f.s. #2	70	90	95
Lakeland f.s. #2	97	90	90
Gainesville l.f.s.	55	55	55
Lakeland f.s. #3	47	40	35

Man and Nature Join To Build Soil Tilth

MAN must join forces with nature to do the best job of building tilth in his fields, says John A. Slipher, Extension Agronomist, Ohio State University. According to him there are two means to give soils "friable and fluffed-up physical tone." Such tone is called "tilth, good condition" and other terms that farmers use.

The two means are roots of sod crops and correct tillage. Slipher says, "No less than half the years of the cropping cycle in sod will suffice to create enough crumb structure."

Alfalfa and sweet clover are the best soil structure builders. True clovers, such as red clover, rank next among legumes. Among grasses, tall fescue and brome grass are best to create good tilth. Timothy and orchard grass are second.

"Combining a grass with a legume effects most change in soil structure," Slipher points out. Grass forms soil structure that is harder to break down—will take more punishment. Legumes, however, will affect structure deeper in soil than grasses will.

Of tillage, the second means, the Agronomist says, "It applies an external force that trips the mechanism of tilth." It causes natural crumbs, formed by sod crops, to break apart.

Good tilth helps protect investments in fertilizers. It regulates soil ventilation, film moisture, and root growth. When land is in row crops, tilth deteriorates and must be renewed. Poor drainage also damages soil condition.

Hybrid Vegetables

HYBRID vegetables may soon become a reality on American dinner tables, a University of Wisconsin horticulturist told a session of the American Institute of Biological Scientists at a recent meeting in Madison. W. H. Gabelman reported that production of hybrid seed for many of our vegetable crops is now possible—which means bigger yields and better quality.

Hybrid is a word that has been associated with tremendous increase in corn yield and quality, he said. But hybridization has never been too practical with other crops. One of the major difficulties was finding an economical way to crosspollinate the inbred lines of these other crops, he pointed out.

Corn plants are easy to handle in this work. Pickers merely go down the corn rows and detassel the plants to be saved for seed. Nearby male plants then furnish the only pollen. And the seed plants do not fertilize themselves. But other crops do not lend themselves to this "detasseling" process.

Now, Gabelman reported, we have developed some vegetables and flowers where the seed parent develops sterile pollen. Producers of the hybrid seed will not have to go to the very tedious work of removing all pollen-carrying parts from the seed plants.

He said that sweet corn, onions, beets, carrots, and petunia hybrids are already being developed from pollen-sterile plants. Other plants which could be hybridized are rye, celery, swiss chard, and many of the flowers.

Some plants, such as beans, tomatoes, peppers, peas, lettuce, and wheat may never be worked into the hybrid picture.

These plants are largely self-pollinated. Wind or insects do not carry pollen from plant to plant. Where plants are self-pollinated it doesn't appear practical to work out the hybrid process.

The key to this latest discovery is that pollen sterility can be developed in plants. And Gabelman hinted that pollen sterility can probably be induced in many of the cross-pollinating crops. He explained that certain strains of a plant gradually change genetically by natural means. They may even develop into different species. Some of these new lines, when crossed with some of the old lines, develop the sterile condition. He pointed out that the exact nature of the factor for male sterility remains unknown—but the process for developing it is now clear.

Build Farm Plan Step by Step

THE most profitable farm plan is built logically, step by step. You take the steps in order, but one is as important as the other.

Size up your situation first, says Leonard Kyle, Farm Economist of the University of Illinois. Inventory your resources. How good is your soil? How heavily can it be cropped? What's your best market? How much labor do you have?

Next, plan your crop rotation and fertility program. Grow crops that fit best and are most profitable. Also, plan to keep your soil productive.

Last, plan your livestock program. Use livestock, Kyle says, to supply a market for resources you can't use in other ways. Roughage, for instance, has no good market except as livestock feed. Many farms have labor that can't be used profitably except through the production of livestock and livestock products.

Livestock vary in the amount of roughage and labor they need. Pick livestock that will make full use of plentiful resources and that stretch out scarce ones.

Outdoor Manger Replaces . . .

(*From page* 21)

severe weather, they chose to bed down in the pasture. The other cows, even with bedding and under loose housing, required more grooming except in rainy weather. The cows did not cut up the pasture by trampling but they became muddy in gateways and lanes leading to the barn.

From these tests and others where cows have made satisfactory and economical production on pasture alone or with the addition of limited grain feeding or with either grass silage or hay with grain, it appears sound to increase the emphasis on roughage feeding programs. Under present government support programs, liberal concentrate feeding is relatively expensive. But under modern milk-pricing systems, it becomes more important to strive for maximum milk production from September to March and the economical production from April to August largely on roughage. The two ideas are really compatible. With every effort, including heavy fertilizer use toward good forage production and labor utilization in winter feeding, grain feeding can be adjusted to production. During a mild winter, moderate grain feeding is practiced; in severe weather more grain is fed and more cured forage made available from stack or silo. With surplus prices of

spring, grain feeding is cut sharply as the production of grass increases and the poorest cows are culled. Surplus grass and hay are cut early for feeding in dry weather or for the next winter.

The dairyman planning ahead may invest more in modern milking arrangement to save labor and improve quality of milk. This may include more paving around the milking barn and its approaches or where silage or hay is to be fed.

Hay storage sheds and perhaps self-feeding horizontal silos in the pasture that later afford livestock protection from the cold wind or rain, plus trees, may be all the barn needed, in the South at least. When I mentioned this possibility to the late Dean M. J. Funchess of Alabama, that outspoken agronomic authority said: "Now you livestock men are making sense." We learned from the cow that it makes cents.

Conditioning Soils . . .

(*From page* 24)

its topsoil when a storm dumped 18 to 20 inches of rain over a small area within daylight hours one day in the spring of 1952. The owners of land like that—and you'll find them all over the Southwest—are concerned with holding the soil they have, with getting organic matter into it for year-to-year use, with maintaining or increasing its productiveness. They have no way of building 10 inches of topsoil in 10 or even 20 years.

Another thing that farmers are learning is that soils have limited capacities and adaptations for certain crops. In many parts of the Southwest, for example, soils are not naturally rich enough or are too susceptible to wind erosion to be put or kept in clean-tilled row crops. Some, by their very unchangeable nature, are limited and adapted only to permanent grass. As

Fig. 4. Here is a simple device used to show a characteristic of soils. Two glass jars are filled with water and wire baskets inserted into the tops. When soil from a field worked to death with clean-tilled crops is dropped into the basket, it seems to explode—falls apart and fills the bottom of the jar (left) like mud. It is not stable in water. Soil taken from a pasture stays intact when it is dropped into the basket in jar at right. It is in good physical condition and absorbs water without falling apart and sealing over.

long as we try to grow clean-tilled row crops in such soils we are going to have trouble. All we can expect to do on severely eroded land of this sort is to bring the erosion under control by establishing a grass cover that can be used for grazing. Such land can be profitable in grass.

Farmers are learning about other characteristics of their soils so that they can get the greatest benefit possible from their use of chemical products like soil conditioners, as well as commercial fertilizers. Depth, texture, permeability, historical erosion and slope are the major soil properties that they are finding useful and important to understand. When they understand these characteristics, they are in a better position to get full value from the use of soil conditioners and to recognize the limitations of mechanical measures such as deep plowing. They can then readily see the difference between temporary relief and permament cure.

More Ammunition

(*From page* 5)

ern equipment and facilities.

Making business decisions for themselves, adopting wiser and better methods, and advancing toward security are the rights and duties of all farm families. But county agents have been actively engaged in helping farmers to reach business decisions. Their role as counselors has been advancing fast through the years. For some time the State extension staffs have been providing county agents with the scientific background required to discuss the farm management problems they face in their daily work.

This is the exact kind of commonsense approach that we mean when we refer to "extension education." It's this system which has made our own agricultural extension work a model for the whole world. Many other countries with rich agricultural science storehouses have seldom linked the college with the farm in any direct way. The facts of life have been locked up tight in the lofty towers of academies. The farmers got little of it for their small and scattered holdings.

Here our farmers are eager for the newest methods and formulas to rid them of pests and guide them to success. The entire educational level of the rural people has been raised and, along with it, their demand for constantly better farming methods has been hard on the heels of discovery and invention.

A research man told me lately that he gloried in the potency of production here in America, but that this wonderful thing has not been an altogether unmixed blessing. Each new solution and each development have brought along with them new problems which were not so pronounced before. Larger cost outlays follow much of the new and marvelous technology farmers use widely. More of the gross farm income goes right into extra cash expenses to keep the wheels all turning right. Farms are actually commercial plants these days, and every time a day laborer is dispensed with by new machine or electric power some other perplexity intervenes to make farm planning more essential than ever.

Farmers are geared to electricity to an extent that any widespread damage to power generating or transmitting systems would play hob with manifold tasks at critical times. This calls for large group business organizations to keep watch and ward on the new frontiers of farm production, alert to sudden circumstances and conditions which the horse-and-wagon days never had to face.

Most important of all in surveying our research and extension deal we come to recognize that much more

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capital is required these days to own and properly run a good-sized family farm. But many farmers find themselves woefully lacking in an understanding of business principles or managerial training. Youth just finding out for himself what farm operations mean and others who have recently taken over a new piece of land are especially beset with the jitters in business adjustments and managerial plans.

Maybe it is partly in this field that the proposed expansion of our extension forces has the most promise. The local county staff know the real conditions in question and are able to apply their broad general skill in farm management and allied sciences to aid the farms where help is most needed. In many cases on record, groups of neighborhood farmers have assembled with the specialists of the county staff to discuss the vital problems that seemed to be the closest and most pressing for solution. Right in recent weeks we have seen fresh pictures of these doings. Wheat farmers faced with curtailment of marketing quotas have wanted to plan for substitute crops, while the dairy and beef cattle interests have been in the "snare of the fowler" recently, crying hard for a quick way out.

As our agriculture grows more intensive and complex and our surplus above saleable levels increases in response to science and practice, we are going to need a mighty useful and workable research and extension force. It will not be able to offer alibis or excuses or postponements. No form of new mass media of information, either plain or colored, will keep the unprepared scientist and educator from wearing a pretty red face.

Then we will be at another kind of extreme indeed. Thirty years ago we had so much new science available that it went begging for farm takers. Now we have a hungry lot of hard-pressed farmers looking for short cuts and thrift recipes and kill-pest principles. Unless we are all lined up and ready to go both in the laboratory and in

the demonstration plot it will be just too bad for tax-paid teachers.

At the outset of this rambling piece it was said that politics and partisan rivalry seldom hamstring the workers in these valuable fields. But adherence to pet projects and special interest pressures is beginning to inject some racket into an otherwise peaceful pastoral scene. The first announcement of this dual emphasis upon research and extension led to some rather sharp criticism and some fears that well-established systems would be torn apart and disrupted.

All this "rouse mit 'em" procedure has probably not hurt the cause at any rate, although it has subjected the new proposals to a keen spotlight. I presume discussion and a few wrangles on the side are graphic ways to focus our undivided attention on the goal we seek.

Whether we are running into more dilemmas or not, whether we actually know the strength of the power within us, it is safe to say that united agricultural voices call constantly for greater net production per man. It's a tidal wave of opinion backed by necessity. That is the only direction we want to go.

Doubtless it will bring hundreds of new problems in its wake. It's the fate of farmers to be forever on the firing line. The era of the backwoods rube is gone. Farming to exist and survive these days must be commercial. But it is also social and home-making and family-rearing. Some of these last elements we can't spell out alone on the same charts that we draft our business plans upon.

Neither can we find this warmest, heartiest value of agriculture locked up in a laboratory or written in a bulletin. But it's the real force that gets behind the farm picture of today. Science and extension that lose sight of this human relationship and the love of farm life which goes beyond new mechanical gadgets need to back up fast and get a head start toward the truth.

Left—untreated onion; Right—treated with MH-40

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producers of seed protectants, fungicides, miticides, insecticides, growth retardants, herbicides; Spergon, Phygon, Aramite, Synklor, MH, Alanap.

FREE LOAN OF EDUCATIONAL FILMS

The American Potash Institute will be pleased to loan to educational organizations, agricultural advisory groups, responsible farm associations, and members of the fertilizer trade the motion pictures listed below. This service is free except for shipping charges.

FILMS (ALL 16 MM. AND IN COLOR)

The Plant Speaks Thru Deficiency Symptoms (Sound, running time 25 min. on 800-ft. reel.)

The Plant Speaks, Soil Tests Tell Us Why (Sound, running time 10 min. on 400-ft. reel.)

The Plant Speaks Thru Tissue Tests (Sound, running time 14 min. on 400-ft. reel.)

The Plant Speaks Thru Leaf Analysis (Sound, running time 18 min. on 800-ft. reel.)

Save That Soil (Sound, running time 28 min. on 1200-ft. reel.)

Borax From Desert to Farm (Sound, running time 25 min. on 1200-ft. reel.)

Potash Production in America (Sound, running time 25 min. on 800-ft. reel.)

In the Clover (Sound, running time 25 min. on 800-ft. reel.)

In Canada: The Plant Speaks Thru Deficiency Symptoms
The Plant Speaks, Soil Tests Tell Us Why
The Plant Speaks Thru Tissue Tests
The Plant Speaks Thru Leaf Analysis
Borax From Desert to Farm
Potash Production in America

DISTRIBUTORS

Northeast: Educational Film Library, Syracuse University, Syracuse 10, N. Y.

Southeast: Vocational Film Library, Department of Agricultural Education, North Carolina State College, Raleigh, North Carolina.

Lower Mississippi Valley and Southwest: Bureau of Film Service, Department of Educational Extension, Oklahoma A & M College, Stillwater, Oklahoma.

Midwest: Visual Aid Service, University Extension, University of Illinois, Champaign, Illinois.

West: Department of Visual Education, University of California, Berkeley 4, California.
Department of Visual Education, University of California Extension, 405 Hilgard Ave., Los Angeles 24, California.
Department of Visual Instruction, Oregon State College, Corvallis, Oregon.
Bureau of Visual Teaching, State College of Washington, Pullman, Washington.

Canada: Canadian Film Institute, 172 Wellington Street, Ottawa, Ontario.

For the Province of Ontario: Distribution Services, Ontario Agricultural College, Guelph, Ontario.

IMPORTANT

Requests should be made well in advance and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of loan.

Request bookings from your nearest distributor.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Reprints

28-12-45 Better Corn (Midwest) (Circular)
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What is the Matter with Your Soil?
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
A-1-44 What's in That Fertilizer Bag?
QQ-12-44 Leaf Analysis—A Guide to Better Crops
P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—The Aristocrat
OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
ZZ-11-45 First Things First in Soil Fertility
T-4-46 Potash Losses on the Dairy Farm
Y-5-46 Learn Hunger Signs of Crops
I-2-47 Fertilizers and Human Health
T-4-47 Fertilizer Practices for Profitable Tobacco
AA-5-47 The Potassium Content of Farm Crops
TT-11-47 How Different Plant Nutrients Influence Plant Growth
VV-11-47 Are You Pasture Conscious?
R-4-48 Needs of the Corn Crop
X-6-48 Applying Fertilizers in Solution
AA-6-48 The Chemical Composition of Agricultural Potash Salts
GG-10-48 Starved Plants Show Their Hunger
OO-11-48 The Use of Soil Sampling Tubes
KK-10-49 An Approved Soybean Program for North Carolina
SS-12-49 Fertilizing Vegetable Crops
F-1-50 A Simplified Field Test for Determining Potassium in Plant Tissue
K-3-50 Metering Dry Fertilizers and Soil Amendments into Irrigation Systems
V-5-50 Potassium Cures Cherry Curl Leaf
X-5-50 Fertilizers Help Make Humus
BB-8-50 Trends in Soil Management of Peach Orchards
II-11-50 Tree Symptoms and Leaf Analysis Determine Potash Needs
I-2-51 Soil Treatment Improves Soybeans
X-3-51 Orchard Fertilization Ground and Foliage
BB-10-51 Healthy Plants Must Be Well Nourished
CC-10-51 Producing Small Grain More Efficiently
EE-10-51 Rotation Fertilization
GG-11-51 Fertilizer Recommendations Based on Soil Tests
II-12-51 Pasture Improvement With 10-10-10 Fertilizer
JJ-12-51 Soil Fertility and Pastures
KK-12-51 Potassium in Animal Nutrition
A-1-52 Research Points the Way to Higher Levels of Peanut Production
D-2-52 Boron for Forage Crops
E-2-52 Ladino Clover—Its Mineral Requirements & Chemical Composition
H-3-52 The Relative Merits of Inorganic & Organic Sources of Plant Nutrients
L-4-52 Efficient Use of Fertilizer in the Southern Region
O-4-52 Tomato Production for the Canning Industry
Q-5-52 Potassium-nitrogen Balance for High Corn Yields
R-5-52 Why Plants Differ in Fertilizer Need and Mineral Composition
T-8-52 Fertilizers Used in 1951 by New York Tomato Growers
V-8-52 Growing Better Turnips
X-10-52 The Mineral Uptake by the Sweet Potato
Y-10-52 The Nutrition of Muck Crops
CC-12-52 The Leaf Analysis Approach to Crop Nutrition
DD-12-52 Potash Deficiency of Reforested Pine and Spruce Stands in Northern New York
EE-12-52 Flue-cured Tobacco Fertilizers of the Future.
A-1-53—Phosphate and Potash Effects on Ladino Clover Swards
B-1-53—Commercial Fertilizer Is a Sound Investment
C-1-53—Wisconsin's Soil Bank Balances Are Running Low on Nitrogen and Potash
F-2-53—Grasses and Weeds—The Potash Robbers
H-2-53—The Diagnostic Approach in Corn Fertilizer Demonstrations in Minnesota
I-2-53—Sericea Is a Good Drought Crop
J-3-53—Balanced Nutrition Improves Winter Wheat Root Survival
K-3-53—Kudzu Keeps Growing During Droughts
L-3-53—The Benedict Demonstration Farm
M-3-53—Soil Testing in New Jersey
N-4-53—Coastal Bermuda—A Triple-threat Grass on the Cattleman's Team
O-4-53—Some Aspects of Fertilizer Use for Potato Production and Tuber Quality
P-4-53—Learning How to Make Profits from Sweet Potatoes
Q-4-53—The Fertilization and Culture of Rosa Multiflora in Northern Indiana
R-4-53—The Sandy Soils of Florida Need Potash for Pastures
S-5-53—More Cotton on Less Land
T-5-53—Trefoil Is Different
U-5-53—Grassland Farming Is Planned Prosperity
V-5-53—Common Sense Management of Southern Pastures
W-6-53—The Development of the American Potash Industry
X-6-53—Pecan Variety Performance Before and After Orchard Was Grazed
Y-6-53—Alfalfa Seed Production in Alabama as Affected by Various Treatments

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THE AMERICAN POTASH INSTITUTE

1102 16TH STREET, N. W. WASHINGTON 6, D. C.

A city girl, telling friends about her brother-in-law's farm, said:

"It's one of those experimental farms where the cows have calves without any bulls around—they call it artificial inspiration."

* * *

Tourists are people who travel thousands of miles to get a Kodak picture of themselves standing by the car.

* * *

There was a knock on the door of the dormitory room.

"May I come in?" said a male voice. "It's the room I had when I went to college here."

"Yes, sir," he continued in reverie. "Same old room, same old furniture, same old view of the campus, same old closet."

He opened the closet door. There stood a girl, terrified.

"That's my sister," said the occupant of the room.

"Yes, sir," he replied, "same old story."

* * *

"My wife has been using a flesh-reducing roller for nearly 2 months."

"Yes? And can you see any results?"

"Sure—the roller is much thinner."

* * *

She—"Why don't we get a taxi?"

He—"Darling, you're beautiful. In a taxi no one would see you, but on the street car I can show you off to everyone."

Two farmers met in Oklahoma last month. Said one, "Hi, Joe. Pretty hot."

"Yeah," retorted the other, "I'd say we were about to have a thaw, if 'tweren't for one thing."

"What's that, Joe?"

"They ain't nothin' froze."

* * *

Two elderly women who rented a summer cottage sight unseen, were dismayed by its isolation. After a few frightened nights, they paid the old man who did odd jobs to sleep in a shed near their door every night. The next summer they took the place again and went to look up the old man. At his cottage they found a sign posted: "Wood supplied, odd jobs don. Narvus wimmen slept with."

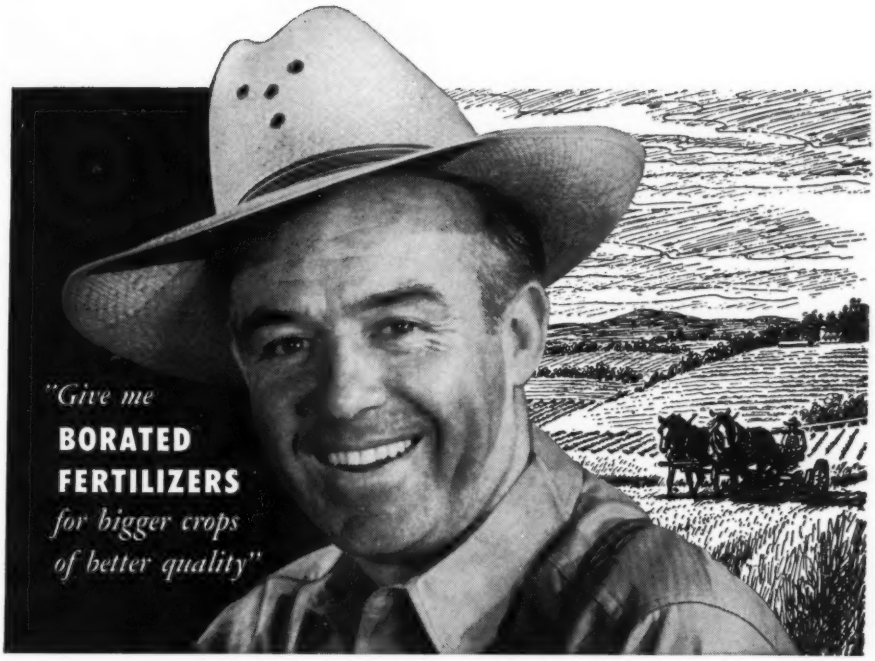
* * *

Girl, to date, as they pass Drive-In Theater: "Oh, let's go see this picture —I missed it last night when I was here with Jack."

* * *

A lady, somewhat embarrassed by the unexpected gift of a baby alligator, placed it in the bathtub temporarily before rushing out to keep an engagement. When she returned, she found this note from her maid:

"Sorry. Ise quit you-all. I doan want to work in a house where they's a alligator. I'd a-tole you but I didn't think the question would ever come up."



BORAX restores lost boron to soil

Yes, Borax does restore lost Boron to soils... the Boron that is so essential to fine, healthy crops and big yields. Although the amount of Boron required is extremely small, its importance is comparable to Nitrogen, Potash and the other essential plant foods. Don't let a Boron deficiency in soil cause crops to dwindle and plants to grow puny. Use Fertilizer Borates, the low-cost fertilizer grade of Borax, to restore the boron—then watch the yields of alfalfa, pasture crops, and many vegetable, field and fruit crops as well, increase and improve in quality!

FERTILIZER BORATE (*equivalent to approximately 93% Borax*) and FERTILIZER BORATE-HIGH GRADE (*equivalent to approximately 121% Borax*) come in fine mesh for addition to mixed fertilizer, or coarse mesh for direct application where required. This material saves you important money in cost of transportation, storage and handling, etc., because water content is held to approximately 24% water (5 mols). County Agents or State Experimental Stations should be consulted for detailed recommendations. Write today for literature!

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